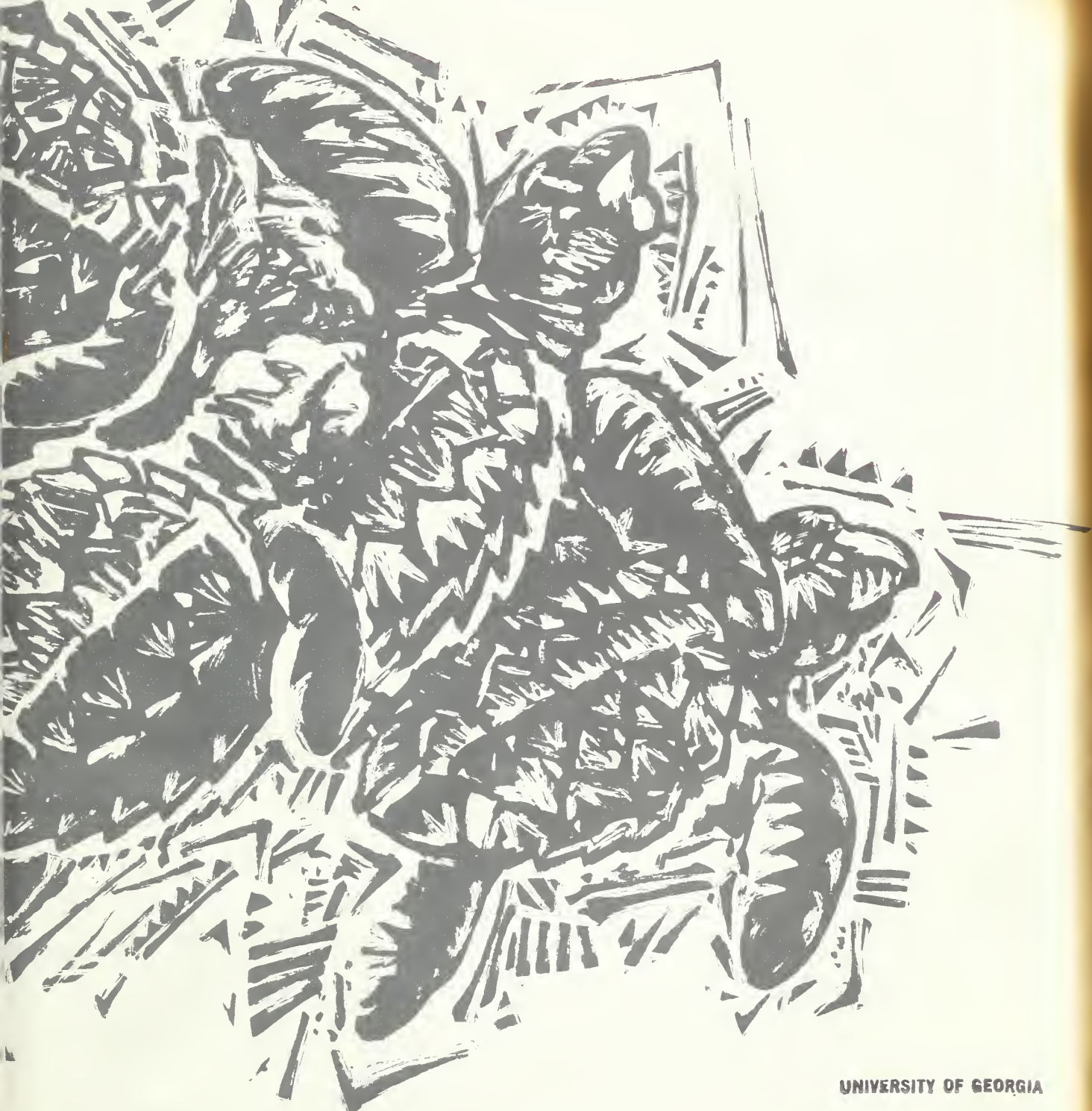


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HIGHLIGHTS OF NATURAL RESOURCES MANAGEMENT 1991



UNIVERSITY OF GEORGIA

Natural Resources Programs
Natural Resources Report NPS/NRPO/NRR-92/07
National Park Service

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1991 Highlights of Natural Resources Management

Natural Resources Report NPS/NRPO/NRR-92/07

Designed and edited by Lissa Fox

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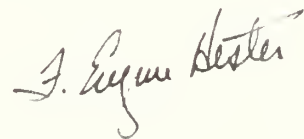
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Introduction

During 1991, the Natural Resources Program throughout the National Park Service made several significant achievements. In some cases, activities of past years came to fruition. For example, several years of effort that began with a regional study of winter haze conditions at Grand Canyon culminated in a negotiated agreement to reduce emissions at the Navajo Generating Station. In other cases, we set a course for years to come. The previously planned Global Change Program achieved a solid foundation with FY 1991 funding and additional FY 1992 funds. Late in the year, with FY 1992 funding, the first year of the planned 10-year Inventory and Monitoring Program was initiated, with selection and funding of four prototype monitoring parks and of a full-time coordinator to oversee the program. In addition to successful initial implementation of these programs, the groundwork was developed for future improvements. The Vail symposium, held in conjunction with the 75th Anniversary of the National Park Service, coincided with internal Natural Resource program evaluation and planning efforts to start strategic planning for the future.

These are exciting times to be a part of managing the natural resources of our parks. The positive changes brought about in key recent issues--the Everglades water quality law suit and reductions of emissions affecting the Grand Canyon and Shenandoah, for example--have provided very visible models of the need for and value of resource data in protecting park resources. We do not yet have the ability to fully accomplish the National Park Service's resource preservation functions. Improvements and advancements in the structure, commitment, tools, and techniques of the agency's natural resource program are needed. However, the many accomplishments of the past year and the mood set by the 75th Anniversary for continued positive change set a positive stage for the future.

A handwritten signature in dark ink, reading "J. Eugene Hester". The signature is written in a cursive style with a large, stylized "J" and "H".



New for '91

*Mouth of Santa Elena
Canyon, Mesa de
Anguila, Big Bend
National Park, Texas*



Can-do Attitude Brings Success

By Robert L. Arnberger, Superintendent, Big Bend National Park

***Note from Associate Director, Natural Resources:** When planning for natural resource programs, we sometimes lose sight of the importance of a will to succeed. Individuals and their attitudes make critical contributions to the achievement of resource management goals. To recognize the importance of the human factor, I asked Rob Arnberger, Superintendent of Big Bend National Park, to write an article about his experiences this past year when the efforts made by his park were not initially awarded with success. I have been impressed by Rob and other superintendents in his position who have found ways to benefit from the investment they made in developing action plans for a budget initiative that Congress decided not to fund. The spirit Rob and his staff have shown in capitalizing on positive experiences should be an example to all of us.*

It was a disappointing day in late October 1991. I had just been told that the Targeted Parks Initiative was a dead duck in budget-balancing waters. The entire staff had participated in the job of developing the proposal, and a vigor had grown from the possibility of its accomplishment. It was hard not to be disappointed, and downright frustrated, when the word came that no special financial help would be coming our way.

However, the glass can be half empty, or it can be half full. Big Bend National Park and International Biosphere Reserve is one of the premiere desert parks on the face of the earth. It combines a unique blend of natural and human history and spectacular geology and paleontology in a setting of "mountain islands separated by desert seas." Yet the science and resource manage-

ment programs of this magnificent park have long been woefully inadequate. Putting together the Targeted Parks proposal focused the park on a course of action required to leap frog the present science and resource management program to where it needs to be. Big Bend had never done that with its resources management plan, perhaps because the plan was not tightly focused into a clear achievable goal, or because it had lost its direction in myriads of forms, project statements, and format straight-jackets. In the course of developing our Targeted Parks plan, we answered the question, "What does Big Bend National Park need, in terms of science and resource management, to respond to the challenges ahead?" By answering this question, we can now focus on the organization required to carry out the work and identify our priority needs.

We have set a firm course to avoid wasting our Targeted Parks effort. In order to implement what we can of the plan, we have broken it down into smaller, more achievable pieces. We are implementing some elements already, and have realized some modest success, certainly enough to encourage us to continue.

Given the budget situation, and all the other problems which affect success, it is easy to become depressed. However, such things do not infringe upon opportunity. The test of our ingenuity and initiative is to continue to press forward, either to find or to create opportunity. To do otherwise is to give up. Giving up would mean not doing all that is possible to protect and preserve this park's natural and cultural resources. We do not see that as an option. Each of us must continue to pursue the vision, create the opportunities, and appreciate each small gain we make.

What We've Done So Far

- We are moving ahead with the reorganization of the resource management division, separating it from visitor protection. Rangers will still be the field resource monitoring and protection unit, but trained resource specialists are essential to establish and build programs.

- Our full-time GIS position will create the necessary and essential computer wizardry needed in a fully operational GIS program.

- The Chief Scientist and Chief of Resources Management have taken two "road trips," visiting key Texas academic institutions, making contacts, and looking for other ways to get things done. We have discovered real potential and excitement at those institutions.

- We are presently exploring grant money opportunities with several organizations, looking for ways to solve some of our most vexing problems.

- In a Cooperative Agreement with Sul Ross State University in nearby Alpine, Texas, we have acquired the use of University office space and institutional contacts for Chief Scientist Keith Yarborough several days per week. This professional contact hopefully will lead us to other academic connections.

- Our interpretive outreach programs now extend into the small Mexican villages opposite the park. These programs target key resource protection goals, such as solving Mexican cattle trespass issues.

- We have continued to foster key political contacts and undertaken cooperative projects with the State Governors of Coahuila and Chihuahua, Mexico, including projects such as training Mexican park managers and outreach to villages.

- We have pushed ahead with a peregrine monitoring program; the program is conducted by volunteers and river rangers.

- Bear-proof trash containers have been placed in strategic locations to ensure that the re-colonizing Mexican black bears do not develop bad habits.

- In-park, multi-disciplinary teams were established and thus far have prepared the initial draft documents for the Fire Management Plan, the Backcountry Management Plan, and a three-year planning effort to complete a River Management Plan. All these planning efforts are consistent with our Targeted Parks plan.

- With only a song and a prayer, we have pushed ahead in cultural resources management as well. We are using Mexican volunteers, paid by volunteer money, to restore the Alvino house, the oldest standing adobe house in the park.

- Several archeological surveys connected with Federal Highway Projects have been conducted. We are beginning a photo survey of all park historic resources.

Inventory and Monitoring Program Initiated

By Gary L. Williams, Inventory and Monitoring Program Coordinator, Washington Office

Many units of the National Park System are being subjected to a wide variety of natural and man-induced impacts and alterations. Left unchecked, these factors could threaten the existence of many biotic communities within the parks. To cope with these diverse changes, park managers and superintendents must have at their disposal comprehensive information about the condition of biotic and abiotic resources in the park and about how those resources are changing over time. Providing that information in a comprehensive and timely manner is the focus of a new National Park Service program.

In fiscal year 1991, the National Park Service initiated a 10-year Inventory and Monitoring (I&M) Program designed to acquire information needed to support managerial decisionmaking in the approximately 250 units containing significant natural resources. This new program encompasses three major activities. The goal of the first activity, the development of a resources inventory, is to collect baseline data on plant and animal communities and physical resources for all 250 units over the next 10 years. The second, a prototype monitoring component, is being implemented to develop the field designs and strategies needed to monitor and detect changes in critical ecosystem components and processes over time. Longterm monitoring will also provide information that will be useful in the development and evaluation of specific resource management strategies. In this manner, information obtained from the I&M Program will assist managers in their efforts to formulate comprehensive resource management plans for the parks.

The third activity of the I&M Program can be considered decision support. The longterm goal of this component is to develop and implement specialized tools and techniques for integrating the biotic and abiotic field data collected through inventory and monitoring. This data will then be synthesized into information needed for effective managerial decisionmaking at the individual park, regional, and national levels. To accomplish this goal, the decision support component will make extensive use of computer-based technology, including geographic information systems (GIS), data bases, mathematical models, and information networking protocols.

The monitoring component of the I&M Program was initiated in October 1991 when the National Park Service selected four national parks--Denali, Shenandoah, Great Smoky Mountains, and Channel Islands--to serve as prototype, longterm monitoring sites. These particular parks were chosen primarily because they had essentially completed baseline resource inventories. These parks also face resource management issues and challenges common to a number of other parks throughout the system. An important longterm goal of the I&M Program is to build a network of 8-10 prototype monitoring parks which can be used to develop and field test various paradigms for effectively and efficiently accomplishing natural resources management in parks Servicewide. The following sections briefly describe some of the major resource management issues in each of the four prototype parks and how monitoring efforts are being designed to address those issues.

Denali National Park and Preserve

By Lyman Thorsteinson, I&M
Coordinator, Alaska Region

Created in 1917, Denali National Park and Preserve in Alaska will celebrate its 75th anniversary in 1992. The park boundary has changed several times over that period and now encompasses an area of 6,025,644 acres. Therein lies perhaps one of the greatest resource management challenges facing the Denali staff: How do you effectively manage an area of wilderness approximately the same size as the state of Massachusetts? Work carried out at Denali takes on added significance when one recalls that the Alaska National Interest Conservation Act of 1980 added new land and new areas to total 53 million acres of Alaska managed by 15 administrative units. These areas are pristine and very little is known about their natural resources. However, managers are confident that much of the knowledge and experiences gained at Denali will be directly transferable to the other parks in Alaska.

The northern latitude location of the Alaska parks makes them especially vulnerable to resource damage. Consumptive uses in combination with provision for

In Denali's inventory and monitoring program, prioritized watersheds divide multimillion acre areas into manageable units for sampling.



mechanical transportation into new areas, including many wilderness areas, greatly complicates Alaskan park management. Fortunately, a considerable collection of baseline resource data already exists for Denali. The monitoring program for Denali was designed to take advantage of that extensive data base. The program goal is to monitor environmental quality trends over time.

For purposes of longterm monitoring, the park has been divided into five major watersheds which provide a representation of the major terrestrial habitats, aquatic systems, and climatic regimes existing within the park.

Ecosystems based upon prevalent vegetation, from lowest to highest elevation, are being identified for intensive study within each watershed. A system of permanent plots, using cluster plot sampling, is being established in each ecosystem. Vegetation community structure and dynamics are being monitored at designated sites within or near these plots. Related chemical and geophysical parameters, including soil characteristics and depth to permafrost, are being measured adjacent to plots. Small mammal and breeding bird surveys are also being conducted near selected permanent vegetation plots.

Channel Islands National Park

By Gary Davis, Research Marine Biologist, Kate Faulkner, Chief, Resources Management, and William L. Halvorson, Research Biologist, Channel Islands National Park

In many respects, the situation existing at Channel Islands National Park, located along the California coast, represents the antithesis of that at Denali National Park. Established in 1980, Channel Islands is a relatively small, new park. And, unlike the pristine conditions which exist at Denali, Channel Islands is situated within 200 miles of some 17 million people.

Channel Islands' proximity to a large human population subjects it to a multitude of resource management issues. Threats to air and water resources exist throughout the park. Oil drilling rigs and tankers occur in the channel between the islands and the mainland. Human

use and ranching within the park have caused some terrestrial and marine ecosystems to become more deteriorated today than when the park was first established. Invasion by exotic plant species represents another source of management difficulty; exotic plant species or dominated communities now occupy about 67% of the entire park land surface. In addition, the excessive consumptive use of economically important fisheries has caused those populations to nearly collapse.

To deal effectively with these severe resource management problems, the Channel Islands staff has designed and implemented a comprehensive resource inventory and monitoring effort that is helping to shape similar efforts in other national parks. Nearly 500 of the 2,000 species known to exist within the park have been evaluated for longterm monitoring. A conceptual model of the park's ecosystems was used to identify 15 mutually exclusive system components for monitoring. Most of those species are insects or terrestrial plants, but a number of vertebrate species are also being monitored. The park is already well into monitoring kelp forests, rocky intertidal habitats, seabirds, and pinnipeds. Prototype monitoring funds will allow the park to start terrestrial monitoring.

Monitoring strategy at Channel Islands is based upon the belief that organisms integrate the effects of a vast array of ecological factors, including predation, competition, and other environmental conditions that are expressed as changes in population abundance, distribution, and growth and mortality rates. Thus, population dynamics of the selected species are being monitored to gain insights into ecosystem health.

Data being collected through the monitoring efforts at Channel Islands are being stored in a GIS so that park managers can rapidly determine which critical resources are in close proximity to environmental hazards, thereby greatly facilitating their ability to rapidly respond to those hazards. On a higher level, these data are also being incorporated into local area networks (LANS) to expedite information exchanges with other offices, both within and outside the National Park Service.



Dan Richards, a marine biologist at Channel Islands National Park, monitors the percent cover of selected organisms in the rocky intertidal zone. A camera mounted on PVC pipe shoots pictures of a 1 meter quadrat for later analysis.

In Great Smoky Mountains National Park, the bear monitoring program includes checking bear dens to determine reproduction, to check the physical condition of the bears, and to note the characteristics of the den site. As in the picture, these dens are sometimes located in hollow trees, some up to 80 feet tall.

Great Smoky Mountains National Park

By Trish Pattersen, I&M Coordinator, Southeast Region

Great Smoky Mountains National Park, which encompasses approximately 550,000 acres in the states of Tennessee and North Carolina, is world-renowned for the diversity of both plant and animal resources. The park serves as a microcosm of the community types and biomes occurring throughout eastern North America. Some of the greatest scientific contributions to the field of plant ecology have come from work conducted at Great Smoky Mountains National Park.

As discussed above for Denali, longterm monitoring in very large parks presents special problems related to spatial scale. The staff at Great Smoky Mountains National Park has developed an innovative approach to this problem by structuring their monitoring efforts around a hierarchy of five spatial scales; 1) landscape, 2) ecosystem, 3) watershed, 4) community, and 5) species. Within



these spatial levels, 13 key ecosystem processes and components identified in the park's resource management plan are being monitored to determine changes in biodiversity. For example, much of the monitoring at the landscape level is focused on determining how the structure and dynamics of the spruce-fir forest community is affected by air pollution and climatic changes. At the species level, population dynamics of black bear and white-tailed deer are being monitored, since those species are extremely important to park visitors.

Shenandoah National Park

By David Haskell, Chief,
Natural Resources and Science

Shenandoah's I&M program is made up of four major components; ecosystem dynamics monitoring, population dynamics monitoring, watershed process monitoring and modeling, and landscape change monitoring. The program is being implemented in three phases. Money from the current initiative funds Phase II of the program.

Phase I was initiated in 1985. Although the alien gypsy moth invasion was the catalyst for the new program, it was determined at that time that the I&M program would be designed to measure a wide variety of biotic and abiotic parameters that would provide a basic framework for an expanded program in the future. Therefore, a set of 110 permanent terrestrial sites was established, each having three 24 meter square plots, and 17

aquatic monitoring transects on 13 streams. This plot system provides representative coverage of the park and provides the core of the ecosystem approach to resource health monitoring. Also included in the ecosystem program is air quality, meteorology, and solar radiation monitoring conducted at three sites, and the recording of events such as fires, floods, droughts, etc.

The watershed monitoring portion of the program has been conducted in two watersheds since 1980. A third watershed will be added during Phase II (1993). The results of computer modeling of watershed dynamics has been used extensively to formulate management decisions related to resource impacts.

The population monitoring is being developed as a primary focus of Phase II program development. Presently, monitoring protocols are in place for black bear, resident breeding birds, and brook trout. Flora population and distributional data have been collected for threatened and endangered species. During Phase II, monitoring protocols will be implemented for a wide variety of other fauna and flora species.

Landscape monitoring was initiated in 1989 in response to rapidly changing land use in the vicinity of the park. The park's well developed GIS is the primary tool for landscape monitoring and analysis. The GIS themes used in the program include viewsheds, adjacent land use, and identification of important habitat or resource areas in private ownership related to the park. The GIS also is used extensively to determine where to place monitoring sites and to record site locations. Phase II expansion of the GIS will be to record and analyze geo-referenced monitoring data. Phase III of the program is still in the conceptual stage.



At Shenandoah National Park, Jacob Bowman tests for dissolved oxygen at the Upper Whiteoak Canyon Run monitoring site. Along with pH and temperature, oxygen levels are taken twice a year in the spring and summer. Four times a year, samples are taken for extensive chemical analysis.

Ten Years of Training: The Natural Resources Management Trainee Program

In 1982, fewer than 1% of the National Park Service's permanent employees were involved with natural resources management responsibilities on a full-time basis. That year, the Park Service began a long-term training program designed to produce a cadre of qualified natural resource specialists for assignment to parks. As of 1991, 117 people had graduated in five classes from the Natural Resources Management Trainee Program. Most of the graduates are in parks, working as natural resources managers, biologists, rangers, superintendents; others have moved to regional and Washington office levels, or to the Denver Service Center. All have improved natural resources management in the National Park Service by applying their knowledge and expertise to day-to-day resource management activities.

In a time when new threats to cultural and natural resources in the National Park System seem to turn up daily, the benefit of a well-trained group of professional resource managers is clear. Gone are the days when the park ranger could do everything; today, the diverse and complex dangers threatening the System's natural resources require specialists who are able to identify and assess the problem, and develop and implement appropriate management plans.

Resource managers must deal with threats outside park boundaries as well as inside, and so must understand larger, often technical, issues. They function as the link between research and application, and must be able to speak the language of both disciplines.

To produce a group that can meet these stringent requirements, the Natural Resources Management Trainee Program puts participants through a rigorous 18-month training program that includes 24 weeks of courses on such topics as wildlife and vegetation management, fisheries management, fire management, integrated pest management, air and water resources management, ecological restoration, conflict resolution and negotiation, interpretation, policy and law, and budget and contracting, to name a few. The courses change each year to reflect the changing problems faced by the parks. Instructors include experts from the National Park Service, private consultants, representatives from organizations, and university personnel. The program is funded from the congressionally appropriated Natural Resources Preser-

vation Program and from the National Park Service Employee Development Division in Washington, D.C.

The careers of graduates are inevitably changed by participation in the Natural Resources Management Trainee Program. Graduates from the later classes are primarily in park positions as natural resource managers and biologists. Some of the graduates from the earlier classes have made it to superintendent and regional or Washington office positions. By listening to a graduate from each class, we can see the value of the program to the individual and to the National Park Service.



Class I:
Lawrence A. Belli, Superintendent,
Chaco Culture National Historical Park

The Natural Resources Management Trainee Program rounded out the information and skills I've needed in assignments as a park resource manager, in a staff position in WASO, and as a superintendent. Although I had a masters degree in Wildland Recreation and several years experience in interpretation and visitor protection in the National Park Service, I was not fully prepared to

address the broad range of issues a resource manager is required to respond to. The value of the colleagues I met and the friends I made in the Program cannot be exaggerated. Everyone of them, through their dedication, knowledge, challenging intellects, and example, have provided support for me to this day.

My assignment as a resources management specialist at Glen Canyon National Recreation Area working for Superintendent John Lancaster, Chief Ranger John Ritenour, and Resource Manager Vic Vieira gave me experience in the areas covered in the the trainee program. On any given day we had to deal with natural, cultural, recreation, planning, and/or compliance issues. I learned the big picture of what issues face a park and how to evaluate and address them. We also did inventory, monitoring, and work with university, state, and federal researchers. Consequently, we found a significant quaternary paleontological site, and began monitoring the increase of peregrine falcons in the region.

**Class II:
Cat Hawkins Hoffman, Management
Assistant, Olympic National Park**

A couple of weeks ago, I was asked, "How did the Natural Resources Management Trainee Program benefit you and the National Park Service?" The question caught me off guard. I haven't consciously considered the Trainee Program for quite awhile, yet I know my participation in the program continues as a daily influence.

The titles of graduates of the Trainee Program--natural resource specialists--is certainly a misnomer. As a "specialist," I know myself to actually be a "generalist," albeit within a specific group of disciplines. Recognizing the realities of resources management in the National Park Service, the Trainee Program did not attempt to create experts in any one discipline, but provided exposure to a wide variety of resources management problems and solutions. Whereas my graduate degree in plant ecology had given me a specialty of sorts, the Trainee Program broadened my view, helping me to see the "big picture."

The single largest benefit of the program to my work is that I gained a much broader perspective and a much expanded network of information contacts and sources. I became able to recognize similarities in resources management problems throughout the Park Service, learned strategies for solving these problems, and, through

A park resource manager's position is very different from that of our counterparts in other agencies or central offices, who generally have the luxury of becoming specialists. When I moved to the Washington Office as Wilderness Coordinator, this background in park resources management proved very useful in evaluating the practicalities of proposed policies and regulations. The trainee and park experience in dealing with other agencies and interested, sometimes hostile, publics was worth its weight in gold.

Of course all this has also served me, and I hope the National Park Service, well in my assignment as a park superintendent. Preserving park resources for future generations while providing for their enjoyment by the public today is instilled in all the Natural Resources Management Trainee Program graduates as a keystone upon which all of our technical skills are built.



introduction to many "who's who" experts, was given an invaluable set of tools on which I still rely. In a sense, the program provided a compressed equivalent of several years' experience within the disciplines of resources management.

Additionally, after almost two year of studying, living, and traveling together, our class of trainees naturally became a family of sorts. Undoubtedly, this was one of the most worthwhile parts of the program. These friends will forever be a valuable part of my life, whether we are in frequent contact or not. They remain an effective part of my problem solving network.

Class III:
Judith Hazen Connery, Biologist,
Acadia National Park

I had been a resources management ranger for a little over a year when my supervisor announced that he was transferring, and I would soon become Acting Chief of Resource Management at Acadia National Park. After the initial paralyzing shock, I looked at the resources management issues going on in Acadia and uttered a weak "help!" Looking back on it now, I realize that only one thing saved me; I had recently graduated from the Natural Resources Management Trainee Program.

With that training behind me, and with the help of an ecological technician and two seasonal employees, I managed to survive and prosper in the eight months before the new chief arrived. We coordinated over \$500,000 of research, some on locally controversial issues such as the recent expansion of coyotes into the area. The park recorded its worst air pollution since monitoring began in 1982, resulting in public health alerts and national media attention. An extensive exotic plant management program to protect wetlands was initiated. Peregrine falcons hacked in the park returned to a historic nest site, generating statewide attention. With the help of volunteers we began to establish an annotated bibliography of over 100 years of park natural resources research as a first step toward building a comprehensive programmatic strategy for resources protection. We were exhausted, but proud!

The Natural Resources Management Trainee Program gave me the confidence, broad-based resource knowledge, and support network necessary to survive



that memorable "summer of '88." I frequently consulted with more experienced managers whom I had met in the Program. Training in policy, law, and leadership proved invaluable in managing controversial issues. The Trainee Program provided up-to-date and sufficiently detailed information on such a wide variety of subjects that I could ask pointed questions of researchers proposing work in the park. And on bad days, fellow class members and our trainee coordinator were always willing to lend a sympathetic ear. I now remember that summer as a time of wonderful challenges, opportunities, and accomplishments, as well as continued personal growth.

Class IV:
Bill Schreier, Natural Resource Manager,
Denver Service Center

It was a dark and stormy night. Heavy snow swirled past the window while I worked the lonely midnight dispatch shift in Yellowstone National Park. I read with intense interest an announcement for the Natural Resources Management Trainee Program. Natural resource management was my dream goal, but I had little expectation this might be a personal realization.

For three years, I had been working in Yellowstone as a dispatcher. Living and working within park environments provided a unique and satisfying "backyard" experience, but my goal was to contribute towards pres-



ervation of National Park Service resources through park management. Participation in the Trainee Program resulted in an immediate change in job responsibilities. My job became concerned with staying ahead of controversial and potentially adverse impacts from external activities. My daily routine became bison management issues, geothermal development, and adverse mining impacts.

Management of some of the world's premiere natural resources is one of the greatest challenges the Park Service has to meet. The majority of present and future issues involve threats to the integrity of these resources. My Yellowstone experience offered opportunity and exposure to crisis management of controversial issues,

Class V:
Bobbi Simpson,
Resource Management Specialist,
Jean Lafitte National Historical Park

The Natural Resources Management Trainee Program first entered my thoughts and aspirations in 1985 in my first season with the National Park Service. Five years and nine moves later, the call came, and all my work and effort paid off--I was offered a trainee position at Jean Lafitte National Historical Park and Preserve.

One of the most valuable products of the Trainee Program was the exposure to others in my chosen field of work. Observing how my classmates approached their careers (some ambitious, some content, some specialists, others generalists) has enhanced my ability to make better professional choices. Reuniting with these same individuals over the course of the Trainee Program yielded an extra level of depth and continuity that other training opportunities have lacked. In addition, through the cumulative six months of training, weekend excursions, homework assignments, reports, etc., I developed a sense of what it would be like to work in 21 other locations--from the action packed regional and Washington offices, to the grandeur of wilderness sites, to the unique character and challenges of urban parks. I was exposed to a wide spectrum of issues, always a valuable learning experience. I found the Trainee Program to be much like introducing one to the Dewey Decimal System of a natural resources library and then providing exercises using the system.

A fascinating strength and dimension to Class V was the diversity of approaches and the similarity in values. In the age-old dilemma of preservation vs. use, I found it

but after completing the Trainee Program, my job altered to one of resources protection through participation with general management plan development and advanced planning. As a result of the training program, I have temporarily traded hands-on park involvement for the learning experience of program management and resource planning with the Denver Service Center.

Now an ex-trainee, I can look back and assess that the Natural Resources Management Trainee Program provided tangible and marketable skills beneficial to both the Park Service and myself. From a personal perspective, intangible values exceeded newly acquired skills. Increased confidence and a broader perspective greatly assisted with my personal development and career.

invigorating to be around other natural resources advocates (dare I say, staunch preservationists?).

As I see it, the true value of the Trainee Program will unfold as the years pass, both for myself and the National Park Service. My ultimate gain from the Program is the creation of a multidisciplinary fabric of contacts and associates and a newly-developed sensitivity to ecosystems-approach management. The ultimate benefit to the Park Service is the cultivation of a broad resource alliance, which can protect our treasures against the multitude of resource threats.



The National Natural Landmarks Program

By Bill Commins, NNL Program Assistant, and Anne Frondorf,
Chief, Planning and Information Branch, Wildlife and Vegetation Division

During a routine survey of the Alaskan peninsula for the U.S. Geological Survey in the early 1920s, R. H. Sargent reached the top of what he thought was just another mountain. To his surprise, below him stretched an enormous crater, easily 30 miles wide. A volcanic vent rose over 2000 feet from the crater floor, its mouth filled by an ash-rimmed ice field. Northeast of the vent mountain lay a blue-green crater lake, the source of the Aniakchak River.

Sargent was stunned, writing that the crater was the largest he'd ever seen and that "You might tuck Katmai [Novarupta volcano] into one end and hardly know it was there." Later research confirmed Aniakchak as one of the largest explosive volcanic calderas in the world. Studies also discovered that the Aniakchak River attracted a unique species of salmon to spawn in its waters. And the area fascinated botanists, who studied natural succession after the deposition of 30 feet of ash in 1931. In addition, because of its remote location, the caldera served as a wildlife sanctuary for caribou, brown bear, foxes, and numerous songbirds.

The NNL Program In 1970, the Secretary of the Interior recognized the significance of the Aniakchak Crater by designating the area as a National Natural Landmark. This designation made the Crater a part of the relatively young National Natural Landmarks (NNL) Program. The NNL Program was established in 1962 for the purpose of identifying and encouraging the preservation of nationally significant natural areas. Similar to the older National Historic Landmarks Program, the NNL Program evaluates and recognizes qualified sites in both public and private ownership without acquiring them.

What the Program is looking for are the best examples of the types of biotic communities or geologic features that characterize a defined physiographic region of the United States, Puerto Rico, the Virgin Islands, or the Pacific Trust Territories. These sites may include examples of geological features, such as Aniakchak, that record active geologic processes or portions of earth history. Or a site may contain fossil evidence of biological evolution, as does Rancho La Brea in Los Angeles; this park contains pits of natural asphalt tar in which Pleistocene animals became entrapped in their quest for

fresh water, and has yielded large and diverse fossil remains. A landmark may also be an example of a distinct terrestrial or aquatic ecosystem; in Georgia, Okefenokee Swamp's 343,850 acres provide refuge for an amazing diversity of native flora and fauna, including many uncommon, threatened and/or endangered species. In considering whether a site may qualify for possible designation as a National Natural Landmark, the Park Service considers illustrative character, diversity, rarity, and value for science and education. Sites where landowners have indicated their consent to designation are extensively evaluated, and qualified sites are then recommended for landmark status. To date, 587 sites have been designated as National Natural Landmarks.

National Natural Landmark designation does not change ownership of a site, nor does it dictate activity. Each site is managed and protected by the owner on a voluntary basis. However, federal agencies are asked to consider the unique properties of the natural landmarks in NEPA compliance and there may be state or local planning or land use implications resulting from NNL designation. In addition, the National Park Service monitors the condition of designated NNLs and each year, as required by law, prepares the Section 8 report on damaged or threatened NNLs for the Secretary of the Interior to transmit to Congress. This report identifies all NNLs with known or anticipated threats to the integrity of their resources. A parallel report is prepared for National Historic Landmarks.

Program Issues in 1991 During its 30-year existence, the NNL Program has functioned as a low-profile, scientific Program. The Program had no formal regulations until 1980. Thus, many of the 587 current NNLs were designated before formal procedures existed. Within the last three years, the Program has been the target of some intense public scrutiny and criticism, centering on whether landowners have been adequately notified and involved in the designation process. To address these concerns, the Park Service has undertaken a series of corrective actions.

On November 28, 1989, Director Ridenour placed a moratorium on the NNL Program, during which the National Park Service will not take any actions regarding

the consideration of new sites for NNL designation. The moratorium was implemented to provide time to review and take actions to improve the NNL Program, and to revise the Program's regulations and procedures.

The National Park Service published the proposed revised Program regulations for public comment in the Federal Register on November 21, 1991. During the comment period, the Park Service held public hearings on the proposed regulations in nine cities around the country. The proposed revised regulations include provisions to strengthen landowner notification procedures, requirements for owner consent prior to designation, and review of all future NNL nominations by the National Park System Advisory Board. A detailed NNL Program

handbook is being developed that will provide specific procedural guidance based on the final revised regulations.

The National Park Service has also undertaken a national effort to corroborate the names and addresses of all current owners of the 587 designated NNLs. Approximately one half of the NNLs are administered solely by public agencies; approximately one third are owned entirely by private parties; the rest are owned by a combination of the two. Private ownership information is being collected by a private contractor, TechLaw Inc. Federal and national conservation group ownership is being confirmed by the NNL office in Washington, D.C. The regional NNL coordinators are confirming state and



Aniakchak Crater

local government ownership. All owners will receive notification of their involvement in the NNL Program and information on their rights under the Program. Finally, the Park Service is updating and enhancing the NNL computer information system and improving its file management system.

A \$750,000 budget increase for the NNL Program beginning in FY 92 significantly increased the Service's ability to implement the planned improvements. The NNL Program budget had decreased over the last 15 years, and for several years the regional office NNL functions had received no direct funding; any NNL activities had to be carried out as collateral duty. Most

of the budget increase has been allocated to the regions, allowing each region to support a full-time NNL coordinator position.

The NNL Program continues to be the focus of much attention. Continued sensitivity over the issue of property rights is evidenced by the oral and written comments received on the proposed regulations. As necessary Program improvements continue to be implemented, the National Park Service is endeavoring to address the concerns of the landowners and fulfill the important objectives of the NNL Program to preserve and protect the nation's natural heritage.

The NPS Joins Watchable Wildlife

By Napier Shelton, Writer-Editor, Wildlife and Vegetation Division

Driving down an interstate highway, you see a brown sign with white binoculars on it and a message about a wildlife viewing area. If you follow the binoculars signs, you will end up at one of America's good places to see wildlife. You have arrived at one part of a growing network of sites in the national Watchable Wildlife Program.

The nationwide Watchable Wildlife Program is uniting a spectrum of wildlife-oriented groups to increase wildlife-viewing opportunities, educate people about the needs of wildlife, and promote wildlife conservation. The Program has the potential to become a major window for the public onto the whole biodiversity issue, through interpretation at wildlife viewing sites.

In December 1990, the National Park Service signed a memorandum of understanding with 13 other organizations, agreeing to cooperate in carrying out the Watchable Wildlife Program. The other signers are the Bureau of Land Management, the Fish and Wildlife Service, the Bureau of Reclamation, the U.S. Forest Service, the Army (two offices), the Navy, the Air Force, the Defenders of Wildlife, the Izaak Walton League, the National Audubon Society, the National Wildlife Federation, and the International Association of Fish and Wildlife Agencies. The Watchable Wildlife steering committee, consisting of representatives from the individual signatories, meets at least once a year to plan the next steps in the Program. I am the NPS representative.

The current focus is on preparation of state wildlife viewing guides, which describe some of the best wildlife viewing sites in the state. A committee composed of representatives from land-managing agencies and other groups concerned with natural resources selects the sites. These must meet certain criteria, such as providing a reasonably good chance of seeing wildlife, reasonably safe access, and scenic quality. The very attractive guides are published by Falcon Press in Helena, Montana. Guides have been published for Oregon, Montana, Utah, and Idaho. Ten National Park Service units are represented in these guides. Ten more guides are planned for 1992: California, Colorado, Indiana, North Carolina, North Dakota, Texas, Arizona, New Mexico, Washington, and maybe Wisconsin. Many others are under discussion.

Questionnaire responses in 1991 from 150 parks with significant natural resources indicated strong support for the Program. Many expressed an interest in having the respondent park designated as a Watchable Wildlife site.

After wildlife viewing sites are designated, the goal is to develop interpretation of the needs of wildlife at those sites. The proof of the Watchable Wildlife Program's worth will lie in the public support it builds for conserving viable populations of all species, animals and plants, and the natural communities they form. The National Park Service, with its long history of wildlife conservation and interpretation, can be a leader in working toward this goal.



Work Continues on Wolf Restoration Into Yellowstone

By Wayne G. Brewster, Research Administrator, and Norman Bishop, Research Interpreter, Yellowstone National Park

"Of all the native biological constituents of a northern wilderness scene, I should say that the wolves present the greatest test of human wisdom and good intentions." Paul Errington, *Of Predation and Life*

If the gray wolf is restored to Yellowstone National Park, the park may be the only place in the contiguous United States that has the complete mammalian fauna comparable to that of earlier centuries. It is likely that all the mammalian species that were present in the area when Columbus landed 500 years ago are present in the park now, with that one notable exception.

Native gray wolves were eliminated from Yellowstone, and most of the western U.S., by the mid 1900s. They are listed as an endangered species; a recovery plan was developed in 1980 and the revision approved in

1987. The Northern Rocky Mountain Wolf Recovery Plan offers strategies for conserving wolves in three areas of the northern Rockies: northwestern Montana, central Idaho, and the Yellowstone area. The plan projects that wolves would naturally recolonize northwestern Montana and probably Idaho.

Wolves have already begun to recover naturally in Montana. In 1991, the U.S. Fish and Wildlife Service estimated that there were 50 to 60 wolves in Montana and immediately adjacent in British Columbia. In Idaho, there are widely dispersed yet persistent reports of wolf

activity, but no breeding pairs or packs have been documented. The estimate of wolf numbers in Idaho is less than 15, but this number is not confirmed.

Because of Yellowstone's geographic isolation from areas with established wolf populations, the chances for natural recolonization were judged by the recovery team preparing the plan to be extremely remote. Consequently, the recovery plan proposed establishing a wolf population in the Yellowstone area by restoration as an experimental population.

In 1988, Congress appropriated funds for the National Park Service and the U.S. Fish and Wildlife Service to address four concerns about restoration of wolves to Yellowstone. The two agencies conducted the required investigations by using extensive literature surveys and independent investigations by university scientists, and by consulting various experts from North America, Europe, and Asia.

The summaries of the initial investigations were presented in "Wolves for Yellowstone?" Volume I (Executive Summaries), with the complete manuscripts of the investigators being published in "Wolves for Yellowstone?" Volume II (Research and Analysis)--more than 600 pages of evaluation. Topics of these investigations included options for wolf management both inside and outside of Yellowstone National Park, the potential prey base for wolves in Yellowstone National Park, mathematical simulations of the effects of a restored wolf population on large ungulate populations, and estimation of the effects a wolf population may have on grizzly bears and other carnivores. Additional biological, sociological, and economic investigations are summarized in "Wolves for Yellowstone?" Volumes III and IV.

In 1991, the Interior Appropriations Bill instructed the Secretary of the Interior to appoint a 10-member Wolf Management Committee composed of representatives from the Wyoming, Montana, and Idaho wildlife management agencies; the National Park Service; the Forest Service; the Fish and Wildlife Service; two representatives from conservation organizations; and two representatives from the livestock and hunting community. The committee's task was to develop a wolf restoration and management plan for the Yellowstone National Park and central Idaho wilderness areas and to make its completed plan and recommendations available to the Secretary and the Congress by May 15, 1991.

The committee discussed the roles of the states, livestock predation, management of wolves and ungulates (big game), the public planning process, and the experimental population concept. Alternatives consid-

ered ranged from status quo, restoration as an endangered species, restoration as an experimental population, legislative alteration of the status of the wolf, and legislatively removing the wolf from the endangered species list.

The committee provided its report to the Secretary on May 11 and to the Congress on May 16. The recommendation called for legislation that would alter the status of the wolf and require preparation of state wolf management plans by each state, preparation of experimental population regulations by the Fish and Wildlife Service, preparation of an EIS by the National Park Service, restoration of wolves into Yellowstone, monitoring of wolves in Idaho, and federal funding of all planning and implementation. Congress took no direct action on the recommendation.

The 1992 Department of Interior appropriations bill directed the U.S. Fish and Wildlife Service to prepare an environmental impact statement on wolf restoration in Yellowstone National Park and central Idaho in cooperation with the National Park Service and the U.S. Forest Service. The Fish and Wildlife Service was further directed that the EIS was to cover a broad range of alternatives and the draft EIS was to be completed within 18 months.

From previous plans and studies, issues have been identified related to wolf restoration. These issues range from livestock/pet depredation, compensation for depredations by wolves on livestock and pets, effects on big game species and effects on hunting opportunities to land use policy and possible restrictions of public use of federally-owned land.

As a result of the previous studies and public meetings, an initial attempt can be made to define a possible range of alternatives. Those alternatives potentially include: a no-wolf option (not allowing wolves to recover), the Wolf Management Committee alternative (removal from endangered species list, with state management), restoration of wolves as experimental populations, a no-action alternative (natural recolonization from other populations), and restoration of wolves as an endangered species.

Because of the very polarized and emotional aspects of the concept, public involvement in the identification of issues and the development and analysis of various alternatives to address the issues is the cornerstone of the project. Public involvement will be sought at several points during the project: at the issues scoping stage, at the alternatives scoping stage, at the draft EIS stage, and on the final EIS.

Awards Recognize Excellence

Director's Award for Research: Charles van Riper, III, Unit Leader, CPSU/Northern Arizona University

When you read the list of Charles van Riper's accomplishments, you begin to wonder when he sleeps. His publications alone would prove that he burns his share of midnight oil. His research in the fields of ornithology, conservation biology, and wildlife management have resulted in over 100 publications, including four books, 10 book chapters, 13 technical reports, and over 50 papers in peer-reviewed national and international journals. He has served on task forces involving endangered species, migratory birds, and National Park Service publications, to name but a few. He has served as the unit leader of two cooperative park studies units (CPSUs) and is an internationally recognized authority and leader in research on the endangered avifauna in Hawaii, wildlife diseases, and the conservation of avian resources. Given all this productivity, it's not surprising van Riper was chosen to receive the Director's Award for Research.

The list of van Riper's accomplishments goes on. His work with avian disease impacts on native bird species at Hawaii Volcanoes National Park led to a clear understanding of the urgency to remove feral pigs from rain forests. Pig wallows and tree ferns hollowed out by pig feeding provide prime breeding sites for mosquitoes, a vector of bird malaria. Van Riper's work pointed out the need for building pig fences in prime rain forest habitat and removing pigs within these enclosures. This program is well on its way to solving a significant resource problem in both Hawaii Volcanoes and Haleakala National Park.

In Yosemite National Park, van Riper led a study of the impacts of human use on the endangered great gray owl. The studies showed that owls were impacted by visitors using prime meadow nesting and feeding habitat. It was also clear that owls were being killed by cars travelling at high rates of speed near the meadows. As a result of these studies,

speed limits and speed bumps have been constructed in the areas where roads cross near meadows in which owls concentrate, providing greater protection for these rare birds.

While his earlier work has been significant in addressing resource issues, it is at least equalled by his accomplishments as a resource program administrator. As the unit leader for the CPSU at Northern Arizona University, van Riper has created a unique program operated on an ecosystem basis rather than following regional boundaries. This CPSU provides research support for National Park System units located within the Colorado Plateau, which contains three separate National Park Service regions--Western, Southwest, and Rocky Mountain. This arrangement allows the CPSU to address related resource issues throughout the Colorado Plateau. The CPSU is especially helpful in developing and implementing natural resources inventory and monitoring programs, particularly in small parks that don't have the manpower or expertise to develop "in-house" programs.

Throughout his career, van Riper has been energetic and prolific in his scientific research in general, and with National Park Service research, administration, and resource management in particular. His contributions to National Park Service science and resource management programs have been significant. And to Charles van Riper, that's obviously worth losing a little sleep.



**Director's Award for Natural
Resource Management:
Daniel Taylor,
Chief of Resources Management,
Hawaii Volcanoes National Park**

Dan Taylor's greatest contribution to resource management may be his ability to work with people. With this skill, he has convinced everyone from local citizens to agency top brass to cooperate in efforts to preserve and protect the natural resources of the National Park Service. As Chief of Resources Management at Hawaii Volcanoes National Park for 12 years, Taylor has had plenty of opportunities to practice his natural talents. His park has many natural resource problems that cannot be solved without interaction and cooperation between the park, state agencies, other federal agencies, private organizations, and the general public: problems such as endangered species and habitat protection, feral ungulate and exotic plant control, geothermal development, air quality, and cave management.

One of the biggest and best known resource management problems in Hawaii Volcanoes concerns the control of exotic species. Both animal and plant species foreign to Hawaii have invaded the park and are threatening the survival of native species. A major priority for the park is the control of feral pigs and goats. Management of these species has been and continues to be controversial. Eradication efforts generate opposition from local citizens and county and state officials. To implement control measures, Taylor has had to work extensively with government officials and local hunters who have traditionally had access to the park for recreational hunting.

The management of these species in Hawaii Volcanoes National Park has been very successful to date, and the standards established by Taylor, his staff, and regional Park Service scientists have been used by California parks and various organizations and agencies. To manage feral goats, Taylor and his staff developed a method that calls for the use of captured "Judas goats," which are radio-collared and then turned loose to seek out remaining bands of goats. As a result of this program, all fenced areas of the park (approximately 80,000 acres) are free of wild goats, and less than 100 animals remain on several high unfenced slopes.

Before 1979, attempts to control feral pigs with traps and snares were sporadic and ineffective. Working with the superintendent, the resource management staff, and the park's research scientist, Taylor helped to develop a unique plan for creating fenced management units within the park to isolate, monitor, control, and then remove feral pigs. Nine of these units, totalling 18,900 acres and 30% of the pig habitat in the park, have now been cleared of pigs in this continuing program.

Resource managers in Hawaii also have to deal with exotic plant species. Working in cooperation with the park's research scientist, Taylor developed and implemented a plan to control and remove aggressive exotic plant species on a unit by unit basis. His plan prioritized



species control according to mechanical, chemical, or biological means of removal, and is now widely used by other parks. In addition, Taylor helped to develop a CPSU/University of Hawaii research program for chemical control of exotic plants. He also worked in cooperation with federal and state scientists and officials to develop a biological control research program involving insect and plant pathogens.

Hawaii Volcanoes National Park is also threatened by geothermal development. Taylor worked with industry and agency representatives to identify the potential negative impacts of such development near the park, and played a role in a land exchange which relocated the project to another site.

Taylor has shown over and over again his commitment to protecting park environments. For all the projects mentioned above, and for all the many others not mentioned, Taylor clearly deserves to be awarded for excellence in his field.

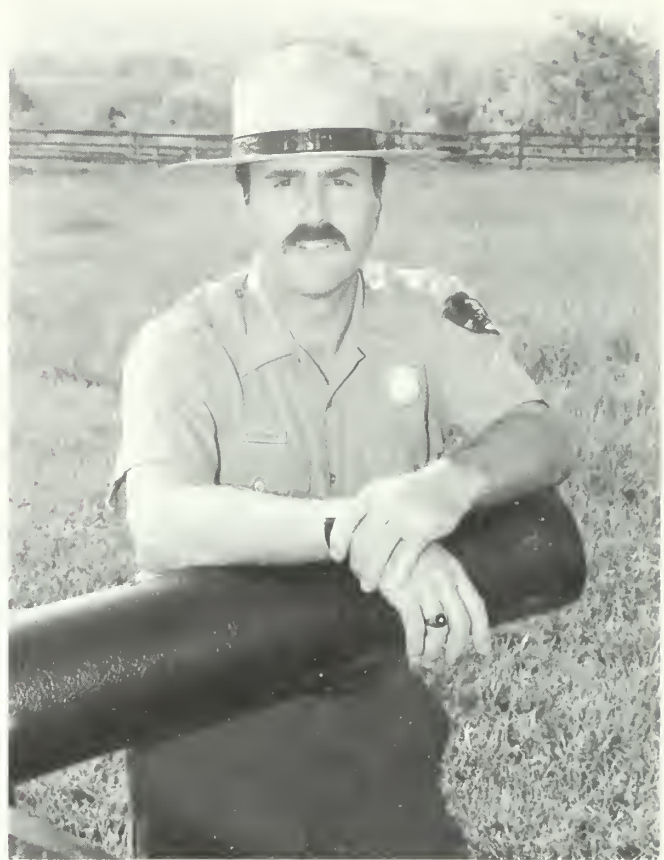
**Director's Superintendent of the Year
Award for Natural
Resources Stewardship:
Richard Rambur, Superintendent,
Antietam National Battlefield**

Richard Rambur arrived at Antietam National Battlefield in August of 1987 to a park rich in natural and cultural resources that were being attacked from both inside and outside the park boundary. Inside the park, the park organization did not effectively deal with natural resources. No one was managing agricultural easements, ground hog damage to cultural resources was serious, and fishermen taking advantage of state trout stocking practices left behind trash and eroded creek banks. The aesthetic values of the park were endangered by plans to build additional historical monuments. And, in some cases, road signing exceeded 90 signs per mile. Exterior natural resource practices threatened the park as well. Subdivision of rural farmland occurred without regard to the effect on park values. A communication tower was being built on a nearby ridgeline and variances to agricultural farmland that would allow a small shopping center went unchallenged by park management.

It was clear that if Antietam was to remain one of the finest examples of a Civil War battlefield, a longterm strategy would have to be developed. With the assistance of others, Superintendent Rambur assumed the leadership role in implementing a strategy to reverse many of these threats.

The first stop was to carefully review park practices. On the recommendation of the natural resource manager, the park stopped the state from stocking trout in Antietam Creek because of the negative impact of several hundred fishermen on the creek bank each spring. Next, a general management plan was prepared that will result in a major scene restoration. Woods and orchards will be replanted, houses removed to restore the historic scene, and 1/3 of the park roads removed and restored to their original trace. The restoration of miles of fence lines to their historic locations and types will not only provide a more accurate historic scene, but also improve wildlife habitat. Over 225 highway signs were removed from 9 1/2 miles of roads to improve the natural/rural scene.

Recognizing that the park could only reach its goals of protecting its natural/cultural resources by changing its organization and improving its use of technology, the park undertook a major reorganization. A second position, an agricultural specialist, was added to the natural



resources operation to deal specifically with the approximately 2000 acres of agricultural lands managed by the park. This was done in part to instill in each employee, regardless of their job, a sense of cultural/natural resource stewardship. And every position in the park now has a computer, except for field personnel. The park geographic information system (GIS), managed by the resource management specialist, will be critical in reestablishing the historic landscape.

In addition, an external program was developed that would raise the awareness of park neighbors concerning the continued loss of their rural environment. As a member of the county's advisory commission for preservation, Rambur was instrumental in securing Denver Service Center involvement in the preparation of a visual landscape analysis using GIS. This analysis resulted in Washington County establishing an overlay ordinance to help protect farmlands and the loss of wooded areas. In addition, Rambur presents programs and works with youth groups and schools to educate the public on the importance of preservation.

Throughout his time at Antietam, Superintendent Rambur has demonstrated outstanding leadership in solving the natural/cultural resource issues of Antietam National Battlefield.

75th Anniversary Director's Award: Dale Engquist, Superintendent, Indiana Dunes National Lakeshore

By Ron Hiebert, Regional Chief Scientist, and
Gary Sullivan, Resource Management
Specialist, Midwest Region

As part of the commemoration of the 75th Anniversary, the Director presented an award to the single individual in the National Park Service who had made the most significant contribution. The criteria considered included achievements in preservation, visitor services, maintenance, personnel management, EEO, and law enforcement.

The winner of this prestigious award was Dale Engquist, Superintendent of Indiana Dunes National Lakeshore from 1983 to the present. Weighing heavily in Dale's favor was his dedication and support of a sound, scientifically-based natural resources management program. Dale considers resource protection in all management decisions at Indiana Dunes, and he understands that intelligent management decision-making requires solid scientific information. To get this scientific information and to spread it around to everyone involved in natural resources management, Dale has created and supported a well-staffed and equipped Research Division, a resources management branch to put scientific findings into management action, and an excellent environmental education program.

The research program at Indiana Dunes supports four research-grade Ph.D.-level scientists, who dedicate no less than 50% of their time to research. The research and resources management groups work closely at all times, sharing projects, data, and personnel. The two groups can concentrate on understanding and correcting the many threats to natural resources at Indiana Dunes. Dale also believes in sharing, and sends his experts out to support research projects in other parks and regions.

The park's inventory and monitoring (I&M) program provides an example of the work that is done in the park. The I&M program is based on the ecosystem approach to park management. Detailed quantitative inventories of the park's vascular plants, bryophytes, mammals, birds, herptofauna, water quality, and air quality have been completed. All are tied to an ecological classification system and a GIS. The inventories were followed by development of monitoring plans. These monitoring programs are presently supported from park base funds and the data used to determine threats to park resources, which are in turn used to set research and mitigation priorities.

By making research and natural resources management a priority, Dale Engquist is following in a long and proud tradition of science at Indiana Dunes. His understanding and dedication to preserving natural resources benefits not only Indiana Dunes, but the northwest Indiana, the Great Lakes Basin, and the whole National Park Service.



Global Change Research Update

by Peter L. Comanor, Global Change Program Coordinator, and David N. Figlio, Program Assistant

1991 was an exciting year for the Service's Global Change Research Program. Together, the 28 research projects already underway or beginning provide a solid foundation from which the National Park Service can build a Program that will significantly enrich our understanding of global change and its impacts on national park ecosystems. Equally important, the results will

enhance the abilities of managers to make resource management decisions in the face of changing climate.

In its preliminary year, the Global Change Research Program began research on 14 projects in six biogeographic areas--Colorado Rockies, Glacier National Park Area, Olympic Peninsula, Ozark Highlands, Southern and Central Sierra Nevada, and Western Great Lakes. In

Research Highlights 1991

- In the Colorado Rockies, researchers are developing models which simulate atmospheric processes to determine the potential effects of climate change. The resulting scenarios will be used to estimate bounds of future climate change for the Colorado Rockies, and make the underlying models useful to land managers.

- Research begun in the Glacier National Park Area includes the modeling of hydrologic processes under current and expected climatic regimes. The Regional Ecosystem Simulation System (RESSys) model being used in this project will also be applied to complementary work in the Colorado Rockies. In addition, investigators are using RESSys on the landscape level as a vehicle to study potential effects of global climatic change on area ecosystems.

- In the Olympic Peninsula, subalpine forest research is utilizing dendroecology to quantify growth responses of tree populations to environmental change over 500 years, and palynology to investigate past changes in forest communities over the past 12,000 years. The resulting data will evaluate the range of possible forest responses to potential changes in climate. Additional work at Crater Lake uses tree-ring and climate correlations to refine the existing water budget-lake level model to estimate pre-1900 lake level fluctuations.

- In the Ozark Highlands, researchers are developing climate-sensitive tree-ring chronologies. This work complements the reconstruction of hydroclimatic variables such as rainfall and streamflow on

a growing season and annual basis for the past 300 to 800 years. Other work commenced in 1991 evaluates the relationship between the current instability of Ozark Highlands streams and natural disturbance rates and magnitudes. These results will assist in the development of a predictive model to assess the future reactions of streams and basins to global and local changes.

- The projects underway in the Southern and Central Sierra Nevada include a forest simulation model for Sierran ecosystems. This forest model will allow us to expand our understanding of climate-ecosystem relations and enable us to make useful assessments of the potential responses of these systems to climatic change. This project will focus on forest pattern, forest hydrology, and fire regimes. Supporting projects gather and analyze necessary demographic data, extend the scale and scope of existing sequoia fire chronologies, and analyze charcoal in sediments for comparison with tree-ring records and validation of the model. Other research will try to document and explain climatic variability and predict vegetation response to climatic change.

- In the Western Great Lakes, researchers have initiated studies aimed at predicting the potential confounding effects of elevated ecosystem nitrogen input, nutrient cycling, temperature, and moisture on boreal ecosystem response to future change in carbon dioxide. Researchers are also assessing whether ecosystem productivity might already be changing due to climatic or other factors.

1992, the Program approved research in five additional biogeographic areas and thematic initiatives--Central Grasslands, South Florida, Coral Reefs, Gulf Coast, and Sonoran Desert, although research was funded in the first two only. The approved research for 1992 potentially doubles the number of active projects in the Program.

A unique aspect of the Global Change Research Program is its large number of linkages and cooperative projects with other agencies and universities. Many projects involve researchers from other agencies whose salaries are partially or fully paid by those agencies. Several projects in the Colorado Rockies and South Florida biogeographic area programs involve significant additional co-funding and support. As the Program develops, these and other cooperative relationships will be expanded whenever possible.

Research commenced this year includes studies of aquatic ecosystems, fluvial geomorphology, tree rings,

pollen analysis, nutrient cycling, fire history, and forest demography, as well as development of forest succession, regional, and landscape-level models. Research scheduled for 1992 includes work concerning sea level rise, hydrology, vegetation dynamics, and other topics.

The Global Change Research Program had a promising start in 1991, as evidenced by some of the work described in the accompanying articles. The five new additions to the list of biogeographical areas with research underway or beginning brings the total number of active areas to eleven, and adds arid, eastern deciduous, tropical, and grasslands ecosystems to the research network. As funding levels increase, the Program can implement research in more of the twenty areas and three thematic initiatives identified to participate in the Program. All in all, 1992 presents unique challenges--and exciting opportunities--as the Global Change Research Program enters into its second year.

The Sierra Nevada

By David J. Parsons, Global Change Coordinator
and Research Scientist, and Nathan L.
Stephenson, Research Ecologist,
Sequoia and Kings Canyon National Parks

The Sierra Nevada global change research program is designed to understand and predict the potential effects of climate change on Sierran ecosystems. With the core study areas focused in Yosemite, Sequoia, and Kings Canyon National Parks, the Sierra Nevada research program proposes to address three broad questions: 1) What changes in the structure, composition, and dynamics of forests are likely to occur as a result of anticipated climatic change? 2) For as many species of plants and animals as possible, what are the likely changes in distribution and the potential vulnerabilities of species to regional extinction? 3) What hydrologic changes are likely to occur?

The first two questions recognize the role of the Sierra Nevada in the preservation of native ecosystems and biotic diversity; the third question recognizes the vital role of Sierran watersheds in supplying water to much of California. The extreme elevational gradient, and corresponding range of climate and vegetation types, rich paleoecological records from tree-rings, meadow sediments and packrat middens, and substantial history of scientific research, make the area particularly attractive for global change studies. The projects directed

toward the first goal, understanding and predicting forest change, fall into three conceptually convenient groups: 1) modern studies, largely designed to provide parameters for (and sometimes test) predictive models, 2) paleo studies, largely designed to test (and sometimes to provide parameters for) predictive models, and 3) predictive studies, designed to integrate the results of the modern studies and paleo studies into models capable of projecting changes in forest pattern under different climatic scenarios, and assessing possible management strategies for adapting to climate change. Projects concerning other goals will be completed when funding is available.

Modern studies currently underway include projects on forest demography, conifer physiology, climate and tree growth relationships, and species-environment relationships. Paleo studies include paleoclimate, paleo fire, and paleovegetation. Predictive studies include fire and fuel dynamics modeling, tree growth modeling, and development of a forest dynamics model. The forest dynamics model will integrate information derived from the other projects into a model that can project changes in forest structure, composition, and dynamics under different climatic and management scenarios.

Early results emphasize close ties between climate, fire, and forest dynamics. Paleoecological studies of tree-rings, firescars, and pollen document a changing environment in the Sierra over the past 10,000 years. As climates have become more moist, vegetation in the mixed conifer forest zone has shifted from an open forest more heavily dominated by shrubs to a more closed forest of fir and sequoia. Periods of warm, dry weather, such as the Medieval Warm Period between approxi-

mately 1150 and 1400 A.D., were characterized by frequent small fires, whereas the Little Ice Age following about 1400 A.D. was characterized by less frequent but apparently larger fires. This interdependence of vegetation, climate, and fire regime indicates the type of changes that might be expected under future climate change scenarios. By understanding past change, researchers will get an idea of the magnitude of possible future change as well as understanding species' and communities' responses to such change. Such understanding is critical to developing and testing the predictive models important to the success of this program. It further emphasizes the importance of managing park ecosystems as dynamic, constantly changing entities, rather than static assemblages of species or scenes.

The Olympic Peninsula

By David L. Peterson, Global Change
Coordinator, CPSU, University of Washington

The Olympic Peninsula is a diverse landscape with a wide range of ecosystems. Sharp elevation and precipitation gradients allow coastal systems, temperate rainforest, and alpine glaciers to exist within 50 km of each other. This compression of life zones provides an ideal natural laboratory for studying potential shifts that could be caused by climate change. Global change research in the Olympic Peninsula Biogeographic Area focuses on Olympic National Park, but also includes Crater Lake National Park, Mount Rainier National Park, and North Cascades National Park. Data were collected for a variety of research projects in 1991, and analysis is underway on several major studies.

By examining tree growth/climate relationships across all life zones, researchers will be able to predict how species distribution could change in the future. The results of studies in subalpine and lower elevation forests will be used to develop predictions of potential large scale changes in the landscape. These changes could involve aquatic systems as well as terrestrial systems. Changes in the condition and quantity of natural resources could also affect human social and economic conditions on the Olympic Peninsula and elsewhere.

Much of the current research program focuses on subalpine ecosystems, where the effects of potential climate change may be most pronounced and detectable. Tree ring data collected during the past year show that

The ultimate success of this program will be largely determined by the degree to which the results of the individual studies are integrated to improve our understanding of which factors most strongly influence the distribution, species composition, structure, and dynamics of Sierran forests and to provide the predictive capability of assessing the changes in forest pattern that might occur under a range of different climatic change and management response scenarios (including the use of prescribed fire as a mitigation tool). The augmentation of limited National Park Service funds through cooperative ventures with universities and other federal and state agencies will be critical to fully funding program objectives, as well as determining the successful regional application of the research findings.

different subalpine tree species have different characteristic responses to various climatic patterns, and that most species are particularly sensitive to snowpack level. Furthermore, the same tree species responds differently depending on its topographic location (e.g., a ridgetop vs. a valley). This suggests a complex response to climate change, rather than a general movement of tree species to higher elevations.

Tree species appear to have expanded their distribution into meadows of the subalpine zone during the past century. It is unclear if climate alone is responsible for this trend, but there were discrete pulses of regeneration during the past few decades. Climate data and other information are being used to interpret this phenomenon.

Information on the potential effects of climate on aquatic resources is being collected at Crater Lake. A model is being developed to evaluate changes in water thermodynamics and circulation for a range of potential climate change scenarios. Weather stations on the lake and caldera rim are collecting data that will be used to develop and test the model. Tree ring records will be used in the future to reconstruct lake levels over the past 300 years.

A variety of other projects are underway, including studies of glacial movement as related to climate, the effects of changing tree distribution on subalpine soil development, and the interaction of fire and climate on tree regeneration. Some of this work is being done cooperatively with other agencies, such as the U.S. Forest Service and the U.S. Geological Survey. The results of these and other studies will be used to predict how terrestrial and aquatic resources in the Pacific Northwest could be affected by future changes in climate and other environmental factors.

Major articles on some of these events appeared in earlier issues of the Highlights Report. The following provides short updates on these ongoing major stories and on other timely events of interest.

Everglades Lawsuit Settled

A Federal lawsuit to require the Florida Department of Environmental Regulation and the South Florida Water Management District to protect water quality in the Lake Okeechobee-Everglades ecosystem has been settled. The suit aimed to limit the discharge of phosphorus and nitrates from agricultural runoff. The United States and the State of Florida agreed on a settlement that was accepted by the court on December 4, 1991. The agreement contains performance-based water quality standards, gives the state 10 years to clean up the water, and provides for continued court jurisdiction to enforce the settlement. Agricultural interests opposed the settlement and have taken legal action to block the agreement's implementation. These interests want to see a market-based approach to reducing phosphorus.

Fisheries Emphasized in 1991

Early in the year, the National Park Service participated in a Department of the Interior fisheries working group, drafting the fisheries section of the Secretary's "Enjoy Outdoors America Initiative." Simultaneously, the Park Service developed and released "A Heritage of Fishing: The National Park Service Recreational Fisheries Program." This publication presents a comprehensive and challenging program, outlining future actions by the Park Service to provide quality recreational fishing opportunities while preserving the natural aquatic systems of the parks. The goals include protection and preservation of fishery resources, research and development, information management, and educational outreach. Beginning next year, a fisheries biologist working at the Washington Office level will coordinate the Recreational Fisheries Program, working with park and regional personnel to implement action items. One of the first actions taken will be to conduct a Servicewide fisheries needs assessment, which will be used to facilitate Program implementation.

Air Pollution Concerns in the Southern Appalachians

In 1990, the Department of the Interior for the first time asked a state permitting authority to deny permits to major new sources of air pollution to avoid adverse impacts on park resources. The action was in response to applications from 20 new coal-fired power plants planned within 200 kilometers of Shenandoah National Park. In 1991, the Department was able to negotiate offsets in three of these cases--for Cogentrix-Richmond, Multi-trade, and Old Dominion Electric Cooperative/Virginia Power. Also in 1991, the Park Service initiated similar efforts to protect air resources at Great Smoky Mountains.

Navajo Generating Station Pollution Control Strategy Set

The Environmental Protection Agency negotiated an agreement on a strategy for control of sulfur dioxide from the Navajo Generating Station to reduce visibility impacts to Grand Canyon National Park. Emissions will be reduced by 90% based on an annual rolling average and the controls will be phased in in 1997, 1998, and 1999. In addition, planned maintenance requiring shutting down units would be scheduled for the winter, when visibility is most impaired by the plant. The agreement was announced by the President at Grand Canyon National Park on September 18, 1991.

NPS-Requested Experimental Flows Granted at Glen Canyon Dam

Changes in the hydrology of the Colorado River from the construction of Glen Canyon Dam have been studied since authorized by Congress in 1982. The Park Service worked with the Bureau of Reclamation for implementation of a recommendation by the National Academy of Sciences to study alternative dam operations. Interim flows were instituted in November 1991 and the effects of these flows are being monitored. The interim flows will remain in effect until the completion of an EIS on dam operations in 1993.

Bison Management Strategies Explored in Yellowstone National Park

Yellowstone National Park is continuing to work in cooperation with other state and federal agencies to develop the Environmental Impact Statement (EIS) for longterm management of the bison in Yellowstone. After reviewing public comments, the group is developing several recommendations for bison management as part of the EIS. The EIS is scheduled for completion in late 1992 or early 1993.

During 1991, there were 136 bison shot outside Yellowstone National Park. As in previous years, the bison were shot under an order of destruct enacted by the Montana Livestock Department and Department of Fish, Wildlife & Parks. This order was enacted by Montana due to concern for the potential transmission of brucellosis between bison to cattle. To date there have been no confirmed cases of transmission of brucellosis from bison to cattle in the greater Yellowstone area. Bison

carcasses are being tested for brucellosis by the Montana Livestock Department. Currently, 11% of the bison have cultured positive for the brucellosis organism. Yellowstone National Park, the Division of Wildlife & Vegetation, and the University of Idaho's Caine Veterinary School are collecting biological samples for diseases, parasites, nutritional status, and genetics.

As a result of this year's bison sampling project, Yellowstone National Park and the Wildlife and Vegetation Division in Washington began a wildlife health pilot project this winter. In July of 1991, the Wildlife and Vegetation Division hired a veterinarian to assist the National Park Service in addressing wildlife health issues. With assistance from the National Park Service veterinarian, rangers, resource managers, and scientists will be conducting a comprehensive health survey on native wildlife species in Yellowstone.





Species Recovery: Cooperation and an Integrated Approach

Working Together to Save Two Butterfly Species

By Laura Nelson, Biological Technician,
Golden Gate National Recreation Area

With a lot of help from their friends, two endangered butterfly species may be able to survive in one of the most densely populated areas of the United States. Found in only four locations in the world, the Mission Blue and the San Bruno Elfin are rapidly losing habitat to the urbanization of the San Francisco Bay Area.

Golden Gate National Recreation Area (NRA) contains two of the four known butterfly populations. In an effort to save the butterflies, park resource managers are searching for effective vegetation restoration techniques while working closely with private organizations, state and federal agencies, and volunteers to implement these techniques.

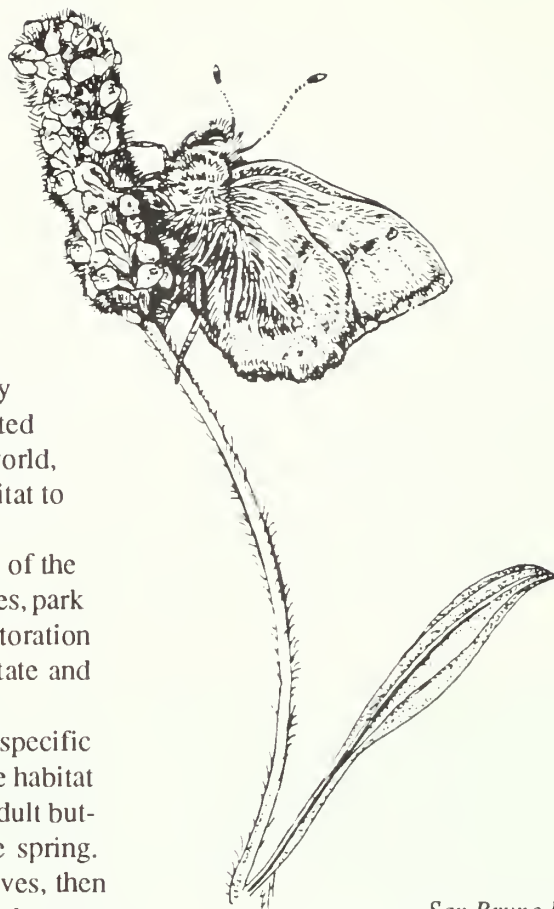
The life cycles of both butterflies depend critically upon specific plants. Three species of lupine provide the Mission Blue with the habitat it needs, while the San Bruno Elfin prefers sedum. Adult butterflies deposit eggs on these plants in the spring. Caterpillars hatch and

Elfin prefers sedum. Adult butterflies deposit eggs on these plants in the spring. feed on the leaves, then spend a dormant phase at the base of

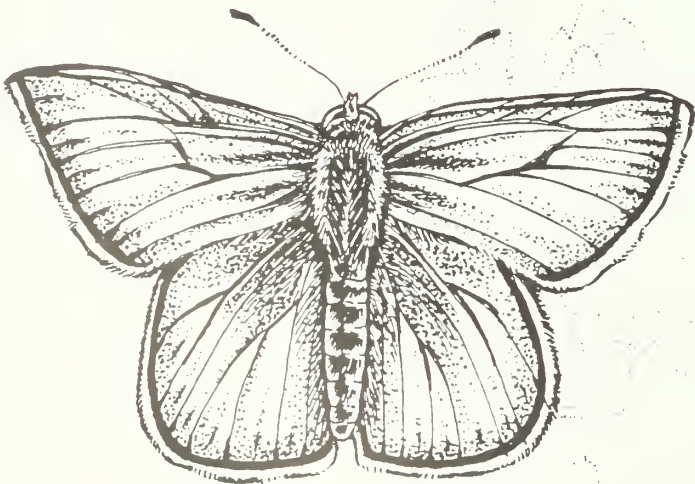
the plants, emerging the following spring as adults. The coastal grassland and scrub communities where these plants thrive have been invaded by exotic plants, particularly French broom and pampas grass. In many areas, native plants have been replaced by dense, monospecific stands of these aggressive exotics.

To improve habitat for the butterflies, the Golden Gate NRA has begun a program of removing the exotic plants and revegetating with the native coastal grassland and scrub species. A number of different revegetation techniques have been tested for their effectiveness in establishing native species and their ability to exclude exotics.

In a three-year study begun in 1991 and funded by the Natural Resources Preservation Program, resource managers at Golden Gate are testing the effectiveness of several different non-chemical methods of French broom removal. The method used most often, manual pulling, has been used in the Golden Gate NRA for many years with moderate success; follow-up visits are required due to the persistence of



San Bruno Elfin



Mission Blue

French broom's seed bank in the soil. The study is designed to show whether native grasses sown at the time of French broom removal will restrict the return of French broom by competing with its seedlings. Researchers are also shading cut French broom stumps with black tarp in an effort to prevent French broom from resprouting after cutting.

Several different methods of pampas grass removal have also been tested, including the use of heavy equipment, bobcats (light bulldozers), and herbicide. A 2-year pilot study conducted in 1989 assessed the effectiveness of different revegetation methods. In this study, a dense stand of pampas grass was bulldozed and buried. Results of the revegetation tests showed that hand-broadcasting a mix of locally collected native seeds gave the greatest overall coverage by natives, and the least amount of invasion by exotic plants.

The park is not alone in its concern for the endangered butterflies. Many groups have cooperated in the efforts to restore butterfly habitat. The Marin Conservation Corps is clearing one hundred acres of French broom and seeding with native grasses. The Habitat Restoration

Team, a highly motivated group of volunteers, can be found hard at work each week restoring disturbed habitat in the park. The California Department of Transportation helps to protect butterfly habitat adjacent to their property by keeping their rights-of-way free of French broom. Following activity on Golden Gate NRA land, the U.S. Army provided funding for butterfly habitat restoration. The Golden Gate Raptor Observatory successfully complied with regulations requiring the restoration of butterfly habitat following their use of Golden Gate NRA land for raptor trapping and banding. Other groups, such as the International Work Camp and the Sheriff's Work Alternative Program, have been employed by the Golden Gate NRA to help control exotics.

It is in this cooperative spirit that the agencies and volunteers involved continue to find encouragement in their efforts to recover the endangered butterflies. Helping these small organisms survive in the face of extinction will help to teach the people of the San Francisco Bay Area that even a densely populated region can reach a harmonious coexistence with species as delicate as the Mission Blue and the San Bruno Elf.

Canaveral Explores Raccoon Management to Protect Sea Turtles

By John Stiner, Resource Management Specialist, Canaveral National Seashore

As early as the 1970s, turtle researchers determined that raccoons were depredating a high percentage of marine turtle nests made on NASA-owned beaches, including Canaveral National Seashore. Approximately 4,000 sea turtles nest on Canaveral National Seashore's 24 miles of beach each year. The vast majority of the nests are made by loggerheads, with a lesser number made by green turtles and an occasional leatherback sea turtle. All of these species are threatened or endangered.

To address the problem of raccoon depredation, in 1984 the National Park Service implemented a nest screening program to aid the turtles. Screening provides in situ nest protection without removing the raccoon, an important component of the seashore ecosystem. Wire screens were placed over newly deposited turtle nests. From 1984 to 1988, as the hours of coverage and number of personnel varied, the percentage of nests that successfully hatched on Canaveral National Seashore beaches

fluctuated. The number of successes rose from 30% in 1984 to 53% in 1985 and then declined to 30% in 1988.

This was well below the 50% nesting success rate required by the Federal Marine Turtle Recovery Plan. On the advice of the U.S. Fish and Wildlife Service, the lead agency for federally protected species, assistance was sought from the Merritt Island National Wildlife Refuge. The refuge operates a turtle management program on six miles of beach just south of Canaveral. It had reduced the predation rate to less than 5% by removing predators, chiefly raccoons, from the beach and dune area.

Because National Park Service policy has traditionally discouraged the destruction of one native species to aid another (i.e., single species management) in favor of an ecosystem concept, a comparative study was initiated to determine the desirability of utilizing predator removal at Canaveral. In 1989, the National Park Service continued screening along the northern 11.25 miles of

Canaveral's shoreline. In the southern 12 miles, the Fish and Wildlife Service removed raccoons.

Screening at night from 10 p.m. to 6 a.m., park staff achieved 81% nesting success in the northern portion of Canaveral National Seashore, while the removal of 250 raccoons by the Fish and Wildlife Service in the southern section of beach attained over 85% success. Screening cost approximately \$5,000 more than trapping.

In 1990, due to the controversial nature of raccoon trapping and lack of data on the overall impact to the ecosystem of large scale raccoon removal, Canaveral resumed screening over the entire 24 miles of beach. Utilizing over 100 volunteers and again working at night, the park was able to achieve 83% nesting success. The effort was aided by the fact that raccoon predation was virtually absent in the southern half due to trapping by the Fish and Wildlife Service in the previous year. Even when raccoons began to reappear in the late summer, few nests were predated. Apparently, depredating sea turtle nests is a learned behavior which the new immigrants had not yet mastered.

However, in 1991, depredation levels increased to equal those in the northern section, indicating that saturation trapping may be effective for about two years. Despite this increased depredation, the overall nesting success for Canaveral was approximately 86%.

The park has shown that screening can be effective in reducing depredation of sea turtle nests. However, the

cost and physical demands on the park staff are high. The alternative measure of predator removal is less costly and more effective. However, in several other areas where raccoon removal has been employed, a large increase in the number of ghost crabs, which prey on sea turtle hatchlings, has been observed. Also, at Cape Romain National Wildlife Refuge, the Norway rat population skyrocketed.

It is highly probably that the raccoon population at Canaveral exceeds historic levels. Protection from hunting, an absence of natural predators, an increase in food from park visitors, and a change in habitat caused by mosquito diking have all created a more favorable environment for the raccoon. However, the raccoon is also a critical part of the seashore ecosystem. Removal of a certain number of raccoons may be necessary, but large scale removal without basic information on population size, age structure, overall health, general food habits, seasonal movements, and role in the Canaveral ecosystem may have undesirable side effects.

Recently, funding was allocated to conduct a study of Canaveral's raccoon population in order to obtain critical baseline data. Hopefully, with this information, a well-informed, long-range strategy can be devised which will protect Canaveral's endangered and threatened sea turtles and maintain the fragile barrier island ecosystem.

Canaveral National Seashore keeps track of between 3000 and 4000 sea turtle nests each year to determine hatching success. Rangers at Canaveral patrol the beach nightly to protect the nests from opportunistic raccoons. Each night, it's a race to see who gets to the nest first, the rangers or the raccoons.



Black-foots Back in the Badlands

By Steve Chaney, Natural Resources Management Branch Chief, Rocky Mountain Region

Black-footed ferrets once ranged from southern Canada all the way into Texas. They lived on the eastern slopes of the Rocky Mountains and in the central Dakotas, Nebraska, Kansas, and Oklahoma. Virtually everywhere there were prairie dogs, there were black-footed ferrets. And for good reason. Not only did 90% of the black-footed ferrets diet consist of prairie dogs, but the ferrets also appropriated the luckless prairie dogs' burrows for shelter.

Unfortunately for the ferrets and the prairie dogs, around the turn of the century westerners launched an all-out prairie dog eradication campaign due to perceived competition with cattle and sheep. Ranchers, farmers, and often U.S., state, and local government agents poisoned, trapped, and shot prairie dogs by the millions. Over the last century, an estimated 100 million acres of prairie dog habitat has shrunk to less than 2 million acres.

As the prairie dogs died, so did the black-footed ferrets. In 1979 the last known black-footed ferret died, and the species was presumed extinct. Then, in 1981, a colony of over 100 was discovered in northwest Wyoming. By 1985, however, that number had fallen to 31, probably due to an outbreak of canine distemper in the ferret population. With the species in imminent danger of extinction, the Fish and Wildlife Service launched an emergency effort to capture all remaining animals and develop a captive breeding and restoration program. By February 1987, 18 ferrets, the last known wild individuals of the species, had been captured.

Since that time, a great deal has been learned about captive rearing of black-footed ferrets, and the number of captive ferrets has increased to over 250. There are many concerns about the survivability of a captive-reared population in the wild due to several factors, including a lack of genetic variability, lack of disease resistance, and the loss of learned wild behavior.

Despite such concerns about the success of a restoration program, initial results are encouraging. The first captive-reared animals (about 50) were released into the wild in southeastern Wyoming in August of 1991. Mortality rates have thus far been substantially lower than the pre-release expectations of 80% or greater.

The restoration plan for the ferrets calls for annually supplementing such releases as necessary and establishing additional re-



lease sites. Another release originally scheduled for northern Montana in 1992 has been delayed until 1993. The next priority release site is within Badlands National Park and the adjacent Buffalo Gap National Grasslands. The plan calls for this release to also take place in 1993.

Preparations for the 1993 Badlands release began over two years ago. Even with this lead time, it will be difficult to finish necessary preparations by the proposed release date. The National Park Service is working with the U.S. Fish and Wildlife Service and the U.S. Forest Service to prepare a draft environmental impact statement by the summer of 1992. Other joint projects include experimental population designation, a management plan, site preparation for a ferret restoration (including research on predator diseases), and inventories of prairie dog distribution and density.

Agencies and private interests in the Badlands area participated in a Coordinated Resource Management (CRM) group established at the request of the Governor of South Dakota. The group was designed to advise the Governor on black-footed ferret restoration. Primarily due to the sensitivity of the agricultural community over prairie dog management, the group could not reach a consensus regarding restoration. However, it was felt

that all parties benefitted from the issue identification and information exchange.

Conservation groups and the general public support ferret restoration. The Governor of South Dakota supports restoration efforts if specific conditions are met. One of these conditions involves U.S. Forest Service lands on which prairie dogs are currently controlled; the Governor supports agriculturalists who do not want any expansion of prairie dog populations onto these lands. Agriculturalists are concerned that ferret restoration will restrict prairie dog control activities in South Dakota and may compromise private property rights.

While NEPA compliance activities are progressing, the South Dakota effort is lagging behind similar black-footed ferret restoration programs in other states due to a lack of state funding and staff for logistics, planning, and public relations work. As a result, the National Park Service and the U.S. Forest Service will be taking a more prominent role in this particular restoration effort. As the process moves forward, all federal agencies will continue to work with the State and local concerns through the CRM process to keep them involved in the NEPA compliance effort.

Cooperative Research and Management Aids the Mexican Spotted Owl

By Mike Britten, Wildlife Biologist, Rocky Mountain Regional Office

Listing of the northern spotted owl as a threatened species has caused an emotional public debate over the value of wildlife and the Endangered Species Act (due for reauthorization in 1992). Less notorious is the Mexican spotted owl. Best distinguished by their range, the Mexican spotted owl can be found from the northern Colorado Plateau and the southern Rocky Mountains of Colorado south through Arizona and New Mexico to the southern edge of the Mexican Plateau. The Fish and Wildlife Service has proposed the owl for listing as a threatened species due to "habitat loss caused by logging and fires, increased predation associated with habitat fragmentation, and lack of adequate protective regulations." Land management agencies in the owl's range have already begun to develop conservation strategies that will encourage the owl's continued survival.

In the past, Mexican spotted owls had been recorded in Zion National Park, Glen Canyon National Recreation Area, Canyonlands National Park, Walnut Canyon National Recreation Area, and other Colorado Plateau Parks. These records gave no indication of the size or permanence of owl populations. In 1989-90, the Rocky Mountain Region and Zion National Park sponsored a thorough inventory and study of the habitat characteristics of the owl in Zion National Park. The research located at least seven pairs and two single owls in Zion and identified high humidity, a high number of vegetation strata, a high percent of ground covered by litter, and narrow canyons as important features of Mexican spotted owl use sites. Habitat use by the Mexican spotted owl is apparently much more flexible than for other spotted owl species, with birds occupying narrow cool canyons

Like its northern neighbors, the Mexican spotted owl may also be a threatened species. Conservation strategies are already being developed to save this species.



with few conifers as well as the familiar mixed-age conifer stands.

National Park Service management concerns for the Mexican spotted owl arise because very little is known about the current distribution and abundance of owls in all parks except Zion, and almost nothing is known of the habitat requirements for a reproductive pair, much less a viable population. Many park areas are now raising the concern that owls residing in parks may use Bureau of Land Management or U.S. Forest Service lands outside Park Service boundaries for foraging or winter use. Land management practices on those lands include habitat altering practices such as timber harvest, brush management (including chaining of pinyon-juniper woodlands), and grazing in riparian corridors.

The few known populations of the Mexican spotted owl on the Colorado Plateau are widely scattered. These populations may be semi-isolated, cut off from other Mexican spotted owls by hot, relatively barren desert. As narrow cool canyons have been inundated by reservoirs and riparian communities disturbed, connectivity of these populations may have been reduced or eliminated and the longterm viability of the populations threatened.

Vital to the efforts to develop conservation strategies for the Mexican spotted owl is research on its habitat requirements, prey use, and movement and dispersal patterns. The Rocky Mountain Region is cooperating

with the State of Utah, the Fish and Wildlife Service, the Bureau of Land Management, and the Forest Service in sponsoring research to address these needs. The work is being conducted by David Willey, a Ph.D. candidate under the guidance of Dr. Charles van Riper, CPSU Leader at Northern Arizona University. David is using radio telemetry to determine habitat use and areal needs and to document dispersal of juveniles. He will also examine prey use and ecology of the Mexican spotted owl. The results of the research will provide a sound basis for developing conservation strategies for the Mexican spotted owl.

Though the owl has not been listed yet, previous cooperative research and management efforts on other land management issues has led to early cooperative work. Land management agencies in Colorado, Utah, Arizona, and New Mexico are working cooperatively to develop conservation strategies for the owl. These strategies will lead to the development of minimum guidelines for protecting Mexican Spotted owl habitat across agency boundaries and may evolve into recovery plans. When the guidelines are completed and endorsed, the Mexican spotted owl will be protected regardless of land ownership and the mandates of individual agencies. This cooperative research and management program may provide a blueprint for future interagency cooperation on a variety of land management issues.

Wolves in Washington State

By Kathy Jope, Regional Resource Management Specialist, Pacific Northwest Regional Office

Wolves are returning to Washington State. Following a period of sporadic sightings and track reports, at least two litters of wolf pups were documented in North Cascades National Park Service Complex. Wolf activity was again documented in the North Cascades in the spring and summer of 1991, and numerous sightings suggest the presence of the wolves extending to the southern portion of the Washington Cascades southeast of, and possibly within, Mount Rainier National Park.

An Interagency Gray Wolf Steering Committee was formed to facilitate cooperation in wolf conservation and management. Members include representatives of the U.S. Fish and Wildlife Service, Washington Department of Wildlife, National Park Service, the National Forests in western Washington, and Animal Damage Control. A

Research and Management Subcommittee and an Information and Education Subcommittee were formed to assist the main committee. Their ultimate goal is to develop and implement a plan for managing wolves in Washington.

An interim control plan, to provide for proper response to any depredations that may occur, has been drafted and will be subject to public review. A monitoring plan is being developed, and a procedure has been established for investigating reports of wolf sightings anywhere in Washington State. The Washington Department of Wildlife is carrying out extensive surveys for wolves in FY 1991 and 1992, with funding from the U.S. Fish and Wildlife Service. The non-profit Wolf Haven is also providing volunteer assistance in documenting the presence of wolves in the Northwest.

Rocky Mountain Region Conducts Bighorn Sheep Initiative

By Frank Singer, Research Ecologist, CPSU, Colorado State University

In the last century, bighorn sheep could be found throughout what is now the Rocky Mountain Region. By the early part of this century, overharvesting, market hunting, and disease dieoffs following contacts with domestic sheep had drastically reduced the native bighorn populations in this area. One of the three subspecies native to the region, the Badlands bighorn, was extirpated. Desert bighorns still occur in the Utah National Park System units, and Rocky Mountain bighorns are scattered throughout the remainder of the region. Following limited restoration efforts, more than half of the recognizable herds in the region number less than 50 individuals, and most of those number less than 25 individuals. Most herds exist as small, isolated groups vulnerable to extreme inbreeding and extirpation due to random events.

The Rocky Mountain region has initiated a program to restore bighorn sheep to all parks, recreation areas, and

monuments in the region. The Bureau of Land Management, the Utah Division of Natural Resources, and the Colorado Division of Wildlife are contributing funding and personnel to the overall sheep restoration effort. With money from the Natural Resources Preservation Program, the Washington Office funded an assessment of needs relative to bighorns for fiscal years 91-93. As part of the assessment effort, six different problem analysis meetings were held between July 1990 and May 1991 involving 14 NPS units. Park and other agency managers attended each meeting along with scientific committees. Since 16 parks requested funds, the cost estimate to work on individual park problems far exceeded the available funds. The consensus of these meetings was to address several major themes on a multi-park basis across the region. The major themes agreed upon were: 1) develop a more accurate census technique, 2) conduct

genetic and disease surveys of existing populations and potential transplant groups, 3) conduct GIS-based habitat assessment of unoccupied habitat, and 4) develop restoration plans on an interagency basis to restore bighorns both inside of and adjacent to NPS units. Restoration on a metapopulation basis without regard to political boundaries was also highly recommended.

Research and inventory efforts have already begun in several park units. These efforts are focused on gaining an overall picture of the current status on sheep and sheep habitat as well as collecting data for use in future sheep management programs. Canyonlands and Badlands national parks are testing a sightability model for application in similar habitats in all Rocky Mountain Region units. In Dinosaur National Monument and Zion National Park, researchers are looking at the problems associated with insularity of small populations. In this project, 70 bighorn sheep have been captured and radio-

collared to date. Blood and tissue samples were collected for genetic and disease analysis. All samples will be analyzed for protein heterozygosity, DNA heterozygosity, DNA relatedness, and DNA fingerprinting. The genetic and disease analyses will guide decisions on locating transplant stocks. Evidence of a lack of genetic variation might require further transplanting in or near some of the smaller groups. In addition to these population studies, GIS-based assessments of bighorn sheep habitat are being conducted in several parks, and interagency working groups or steering committees have been held for all of the units to plan and direct management efforts.

Field studies and further habitat assessments will continue throughout 1992 and 1993. After all of the information gathering stages are completed we hope that a second initiative, devoted just to restoration, will be conducted within the region. Restoration efforts are estimated to take 3-4 and to be completed by 1997.



Fish Restoration Challenges Great Smoky Mountains National Park

By Stephen E. Moore, Fisheries Biologist, Great Smoky Mountains National Park

Visitors often view national parks as pristine ecological islands, rarely understanding that anthropogenic changes may have altered the landscape and fauna. In Great Smoky Mountains National Park, for example, the attempted renovation of Abrams Creek in 1957 eliminated 31 species of fish from the park. This renovation was part of a cooperative effort by the Tennessee Wildlife Resources Agency, the U.S. Fish and Wildlife Service, and the National Park Service to remove all fish from the portion of the Little Tennessee River to be inundated by Chilhowee Reservoir, so that the Tennessee Wildlife Resources Agency could create the "pristine" trout lake of the Southeast. The pesticide Rotenone was used to eliminate all fish from the main river and portions of major tributaries. Apparently, at this time little thought was given to the existence of rare or unique species or to the reinvasion of "undesirable" species from untreated upstream areas.

Fish collections made in Abrams Creek during the renovation effort accounted for 58 species. Thirty-one of these have not been collected since that time and habitat for 20 of these fish existed only in a 2-mile section of stream that is now inundated by the reservoir. Nine of the 11 remaining species are native to the park and can hopefully be restored into the free-flowing segment of the stream. One of the species collected during the renovation, a smoky madtom, was believed to be extinct until 1981, when a specimen was accidentally collected in nearby Citico Creek. Two other species collected in 1957, the yellowfin madtom and the spotfin chub, are listed as federally threatened primarily as a result of man-induced changes in the environment.

In 1986, a recovery team was organized to develop protocols for captively rearing and restoring the two madtom species into Great Smoky Mountains National Park. The team included members from the U.S. Fish and Wildlife Service, the University of Tennessee, the Tennessee Wildlife Resources Agency, the U.S. Forest Service, and the National Park Service. In cooperation

with Aquatic Specialists, a private captive-rearing facility, 535 smoky madtoms and 328 yellowfin madtoms have since been released into Abrams Creek. Since 1987, monitoring efforts have been restricted to the release site and conducted once a year. In 1990 and 1991, one adult male smoky madtom was observed guarding a nest cavity. In addition, a dead gravid female was collected in 1991. No yellowfin madtoms have been collected since their release in 1986.

In 1988, an agreement between the National Park Service and the North Carolina Wildlife Resources Commission was initiated to collect spotfin chubs from the Little Tennessee River. From 1988 through 1991, 769 spotfin chubs were collected and released into Abrams Creek. Limited monitoring in Abrams Creek has not located any of the transplanted chubs. In 1992 an extensive survey of Abrams Creek from the release site downstream to the embayment will be conducted in an attempt to locate any of the transplanted chubs. This evaluation will aid in determining the feasibility of future restoration efforts.

The park plays an extremely important role in the recovery of these three species since it contains one of the few unimpacted drainages suitable for restoration. The restoration of these native species into park waters would help ensure that these species would not be lost to a catastrophic event occurring outside the park. The establishment of self-perpetuating populations within the park is in keeping with National Park Service policy to aid in meeting the goals of the recovery plans for each species, including providing individuals for restoration in other suitable areas outside the park.

Many state and federal agencies in the southeast are following the progress of these recovery efforts and developing similar programs on lands under their jurisdiction. The recovery efforts conducted in the park will provide a baseline of information on program protocols and expectations that could be applicable on a regional basis.



At Padre Island, volunteers patrol for sea turtle hatchlings in a modified "mule." The "mule," donated from army surplus, goes slowly enough to allow patrollers to spot the hatchlings. The shade was added to prevent sunburns.

Cooperating to Save the Kemp's Ridley

John E. Miller, Chief, Resources Management Division, Padre Island National Seashore

Many resources managers face the challenge of balancing a variety of research and resources management projects on a limited budget with limited personnel. At Padre Island National Seashore, the Resources Management Division has addressed and minimized this problem by utilizing a cadre of local volunteers. The volunteers range in ages from 15 to 70 years old and include school children, military personnel, retirees, business executives, and housewives.

The majority of these volunteers assist park staff on resources management projects designed to conserve and protect several sea turtle species. One of these species, the Kemp's ridley, is the most endangered sea turtle species in the world. The volunteers patrol the beach looking for nesting sea turtles, tracks, nests, and hatchlings. From mid-April through August, they patrol approximately 6,500 miles of beachfront.

Many resource managers are somewhat skeptical about using volunteers for field work, believing that the logistical requirements to organize, train, and schedule volunteers is too time consuming to be beneficial. At Padre Island National Seashore this concern was addressed by designating one longterm volunteer as the Division's Volunteer Coordinator. This volunteer is responsible for all aspects of facilitating the volunteer program. We provide the use of a trailer space and pay her monthly electrical bill--a small price for obtaining over 1200 hours of free assistance.

The park recently took the lead in efforts to detect and protect sea turtle hatchlings washed ashore on local beaches. Volunteers and visitors located forty live hatchlings, including 23 Kemp's ridleys. Most were injured and in need of immediate care and stabilization. Unfortunately, there was no local facility available where the hatchlings could be taken for rehabilitation, so most of these baby sea turtles died.

To address this critical need, and realizing that there was no park funding available, we met with executives of Exxon Corporation to explain our problem. After several meetings and slide presentations, Exxon Corporation generously donated the funding necessary to construct a hatchling rehabilitation facility at the park. This facility is the first in the world designed specifically for the rehabilitation of stranded Kemp's ridley sea turtle hatchlings. Hatchlings successfully rehabilitated at the park facility will later be released into the Gulf of Mexico. In a genuine effort to assist the park, Exxon executives and their families joined the Division's volunteers and helped to patrol the beaches for stranded hatchlings.

The volunteer group and the new park rehabilitation facility are part of a continuum of conservation measures that the park has been involved in since 1978 to help save the Kemp's ridley from extinction. By increasing the chances of survival for individual Kemp's ridley sea turtles, park and volunteer efforts may ultimately aid with the overall recovery of the species.



RESOURCE MANAGEMENT TECHNIQUES

Fast Technology for Slow Animals

By Jerry Freilich, Ecologist, and Bob Moon, Chief,
Division of Resources Management, Joshua Tree National Monument

Resource managers at Joshua Tree National Monument have followed the fate of the desert tortoise for several years. Tortoise populations in the Mohave Desert are declining throughout much of their range, so much so that the tortoise was declared threatened in 1990. No one is quite sure why this decline is occurring, although human interference, drought, and disease have all been implicated. Tortoise behavior presents many puzzles to researchers; some areas seem perfect habitat yet are nearly devoid of tortoises, while other areas are tortoise "hot-spots" for less than obvious reasons.

Joshua Tree is searching for answers regarding tortoise behavior by monitoring the tortoises found in the Monument's half-million acres. Now, if you're going to track the status of a species, it's a good idea to know where they are. We decided that while marking and recapturing the tortoises on study plots, we would map their location in space. Our tortoise database shows us exactly where the tortoises are found so that we can focus our census efforts in the "best" areas. We then concentrate our habitat assessments in these same areas, in order to discover why the tortoises prefer these places.

Desert tortoises are not easy to study. Despite the popular image of the slow moving tortoise, the animals are large enough (up to about 18") to cover a fair amount of desert in a day. For this reason, tortoise study sites are usually either a mile or a kilometer square. That's a lot of space! Walking around in a square-mile of desert is similar to being at sea out of sight of land--it's hard to tell where you are.

Finding your position in this square can be challenging. Surveying the perimeter of one site with a transit took three people several days, but that was only the beginning. To know exactly where we stood inside the

site, we would have needed to survey and place 10,000 stakes at the grid corners of each 100-m² quadrat.

Faced with the magnitude of this dilemma, we decided to try global positioning to obtain location coordinates for each tortoise we found and to map and relocate tortoise burrows in the study sites. We used two Nav-1000 Pro Global Positioning System (GPS) receivers from Magellan Systems Corporation. Our first concern was that the GPS units might not provide the accuracy we needed. We were told that using two units



and differential processing we could obtain ± 5 -m accuracy, and we wondered if that was enough. In fact, our concerns about accuracy proved unwarranted. Now when we look for tortoises, each burrow or tortoise is fixed in space with the GPS receiver and the location is marked with distinctive colored flagging. We have found that a single GPS unit, working solo (autonomous mode) provides about ± 15 -m circular error of probability. This accuracy has proved entirely adequate to relocate a flagged burrow days or weeks later.

Using the Magellan's navigate function, we can walk quickly across a half-mile of nearly featureless desert and arrive exactly at the burrow we wish to check.

Global positioning has given us freedom--freedom from surveying, freedom from marking locations, and freedom from doubt about our true position. It has also given us UTM coordinates (equivalent to longitude and latitude readings) to use in developing a desert tortoise theme in our geographic information system (GIS) database.

When we locate active but empty burrows, we take an instantaneous fix. When we find live tortoises, we record a coordinate based on the average of 32 or more positional fixes for better accuracy. The GPS receiver can take 2-D fixes (requiring three satellites) or 3-D fixes including altitude (requiring four satellites). Because four satellites are not always available, and because it takes longer to get data from four, we have found it easier to obtain our elevation by using topographic maps in conjunction with a Thommen pocket altimeter. The altimeter is recalibrated at fixed benchmarks during the day and is reset more frequently if the weather (and barometric pressure) has been changing.

Our field data sheets have a space for entering elevation and UTM coordinates. However, the Magellan unit itself can store up to 60 "waypoints" in a special memory buffer to be easily downloaded back in the lab. In addition, because the unit stores 200 positions at predetermined intervals (e.g., every 60 seconds) in another buffer, we can dump those points to the computer and see exactly where we were that day.

Obviously, the most useful aspect of our tortoise GIS is the ability to look at movement patterns and burrowing activities over time. The map view is invaluable in showing us where to concentrate most search activity. As we add more study sites, information from all of the sites can be easily combined, because everything is UTM based. Best of all, using UTM coordinates from global positioning systems can greatly assist wildlife biologists by allowing any animal that can be fixed in space to be studied using GIS technology. Moreover, using GPS position information also allows the researcher to analyze the relationships of soil factors, vegetation type, and any other related themes in the GIS. Coordinate fixes take only a few minutes and provide enough accuracy for most biological mapping purposes.

Because our budget is limited, we must be highly cost-effective. The project described here is high tech, but it is very low cost. The price of the Magellan GPS receiver is quickly regained in the power and efficiency it gives our staff. The computer and digital video equipment is, likewise, a very modest investment. Any school, research lab, or small business could easily repeat what we have done and adapt these methods to other animals or other situations. In our case, GPS and GIS are the fast moving "hares" that will help save the desert tortoise.

(Mention of specific products does not constitute an endorsement or recommendation by the National Park Service.)

Olmsted NHS Manages Landscape With GIS

By Lilo Gallagher, Geographic Information Specialist, Frederick Law Olmsted National Historic Site

The Frederick Law Olmsted National Historic Site (NHS), located in Brookline, Massachusetts, is a designed historic landscape created by the founder of the American profession of landscape architecture. Olmsted used a wide variety of vegetation to create distinct areas within the grounds of his picturesque, 1.75 acre suburban estate. Today, the National Park Service maintains a living collection of several hundred plant species, many of which are rare and historically significant.

A successful vegetation management program for cultural landscapes like the Frederick Law Olmsted NHS must consider the history and design intent of the property as well as the complex ecological relationships of the individual plant specimens. Caring for natural resources

which have both biological and cultural values requires the collection and analysis of significant quantities of information. The combination of native and exotic cultivated plants in very high densities further complicates management programs.

To meet the needs of this intensively managed landscape, the staff of Frederick Law Olmsted NHS developed a geographic information system (GIS) with support from the Office of Science Studies, North Atlantic Region, and through a cooperative agreement with Boston University. It was critical to research and implement a GIS which would document existing conditions and record subsequent changes, as the site is about to initiate an extensive four-year landscape restoration project

that includes the removal of non-historic material and the replacement of missing historic features.

Due to the specific data requirements and the relatively small size of the site, it was not feasible to use a SUN workstation/GRASS GIS configuration. Instead, the staff explored alternative hardware and software options which would organize the large volume of data spatially and provide a method for flora inventory and monitoring.

First, we inventoried all woody vegetation in the field and tagged each plant with a unique identification number. An electronic survey of the tagged plant material provided elevation points as well as UTM coordinates. Topography, utilities, circulation, boundaries, and structures were also surveyed and coded into discrete layers; these can be viewed either singly or in any combination of overlays. A non-invasive archeological survey, using remote sensing techniques, provided another graphic data layer. This layer will be an invaluable resource for studying the relationship between above- and below-ground features.

Using a computer aided drafting (CAD) program with an integrated database management system (DBMS), we created a template for formatting the data. The data falls into two categories: static and dynamic. Static data includes records for baseline information such as planting date, location, and plant identification by scientific and common name. The plant identification record also contains an index to the site's natural history herbarium collection and to the availability of nursery replacement stock. Dynamic data records, which will be updated periodically, incorporate field condition assessments and monitoring criteria such as tree diameter breast height (DBH), evidence of storm damage, and the presence of diseases or insect pests. These records will be used to schedule routine and cyclic grounds maintenance and special resource management programs.

With this system, resource management can access a central source of data. The GIS will facilitate data management and analysis and provide a format for viewing the changes to the landscape over time.



Frederick Law Olmsted National Historic Site

Mussels Indicate Contamination

By Victoria Mendiola Grant, Natural Resources Management Specialist,
St. Croix/Lower St. Croix National Scenic Riverways

In 1968, the St. Croix National Scenic Riverway became one of the eight original members of the federal Wild and Scenic River System. Recently, however, the St. Croix River within the park has acquired a much less desirable distinction: the river was listed in state public health advisories for polychlorinated biphenyls (PCBs), mercury, and other contaminants in certain fish species.

These advisories, issued by the border states of Minnesota and Wisconsin, recommend limited or zero intake of some fish species for certain age and health groups. The advisories disturb state and federal managers along what is, in many other ways, a premier natural waterway. PCB's are known to be persistent in the environment from historic source inputs, and can enter the food chain through atmospheric fallout, leachate, and resuspension of bottom particles. Mercury levels may be influenced by both historic and present contamination sources, including atmospheric deposition and the release of methylmercury into the foodchain by the acidification of surface waters.

Investigators measuring the extent of contamination in the Riverway are borrowing a technique typically used in marine environments and now expanding to freshwater environments. This technique involves using freshwater mussels as living biological filters. As a normal part of their biological processes, mussels filter water, extracting and incorporating constituents, including contaminants, into their tissues and shells. These tissues and shells can then be studied for signs of contaminant uptake.

Mussels are particularly valuable in this kind of research for two reasons. First, unlike fish, which are typically used in contaminant testing, mussels tend to stay in specific areas on the bed of the river. This makes it easier to backtrack to contaminated "hot spots." Once found, these areas can be further analyzed to determine more detailed information about the level of pollution in that area. The second advantage is that mussels live from 15 to 50+ years. By studying mussels through time, researchers can determine how the water quality has changed over the years.

In 1989, the National Park Service sponsored the collection of a wide-spread mussel, the three-ridge mussel, at four sites along the St. Croix River. The mussels

were frozen, ground, and then analyzed for contaminants. Mercury was detected at all four sites. Utilizing this information, the Wisconsin Department of Natural Resources collected fish species from the most upstream site. Their samples also showed detectable mercury levels, and the Wisconsin Department of Natural Resources recently extended the public health advisory for this section of the Riverway, which had previously not been thought to be of concern.



Another project involves using mussel shells as indicators. The shells consist of annular growth layers, which incorporate elements available in the mussels' environment, including many heavy metals. By aging and analyzing shell materials, growth rates and events of heavy metal contamination can be traced. This information will be used to evaluate spatial and temporal trends in water quality that have occurred since the establishment of the Riverway almost 20 years ago.

For aquatic environments having similar concerns, freshwater mussels may offer valuable records of water quality history.

Managing Prescribed Fire With GIS

By Randy Knutson, Resource Management Specialist, Indiana Dunes National Lakeshore

Indiana Dunes National Lakeshore supports a wide diversity of vegetation, with more than 1,400 species of flowering plants and ferns. Many of these species depend upon wildfires to survive and have begun to decline under a full suppression fire regime. In order to sustain or restore many fire dependent species, Indiana Dunes is expanding its Management Ignited Prescribed Fire (MIPF) Program.

Using the National Lakeshore's geographic information system (GIS) provided an efficient way to obtain the data required to plan a MIPF Program. The GIS quickly provided data on the vegetation types in the burn area, locations of natural barriers which could be used for fire lines, and locations of resources (e.g., structures, threatened and endangered species) put at risk by fire.

The first step in integrating a GIS into the planning process required the development of a fire fuels data layer. Using the vegetation data already in the system, we reclassified 65 vegetation communities into the Northern Forest Fire Laboratory (NFFL) fuel models. These models were used to determine potential fire behavior, such as rate of spread and flame height. The amount of fire fuels and their location were then used to determine ignition patterns.

We used other spatial data in the planning process. We categorized areas of open water and open sand separately, and developments, such as park buildings

and private homes, were displayed as a unique category. Finally, several vegetation classes that did not fit into the NFFL fuel models were classified as wet forest. (Wet forest was defined as all areas generally too wet to burn in an average year that could serve as a natural barrier during a burn.)

In the early stages of planning the MIPF Program, the GIS helped to determine the project boundary of burns, and displayed areas that could serve as natural fire barriers. By using all available natural barriers, it was possible to conduct a burn that required very little control line construction and avoided all known threatened and endangered species. Once the project boundary was determined, we used the GIS to calculate the acreage of each fuel type located within the proposed burn area. Then, using the software packages RXWINDOW and BEHAVE, the acreage figures were used to help determine the weather conditions under which the burn could safely be conducted while still meeting management objectives. Finally, we used this information along with topography to determine the resources necessary (e.g., fire fighters, engines) to contain the burn.

Our GIS has provided a means to streamline some of the procedures in developing MIPF plans, and will continue to serve as a valuable tool in fire management at Indiana Dunes National Lakeshore.

Jamestown Island Fisheries: A Prelude to Management Actions

By Chuck Rafkind, Natural Resources Management Specialist, Colonial NHP, and
Albert J. Spells, Fishery Biologist, U.S. Fish and Wildlife Service

In the early 1600's, English settlers described Jamestown Island's incredible aquatic abundances in their reports of striped bass so numerous that they could fill a 100-ton ship and "more sturgeon than could be drowned by dog or men." Located only 33 miles from the Chesapeake Bay, the largest estuary in the world, the waters

surrounding Jamestown Island have provided abundant aquatic resources, recreational opportunities, and aesthetic pleasures for years.

Jamestown Island is a unit of the Colonial National Historical Park (NHP). This park includes over 40 miles of tidal shoreline along the James and York Rivers, and

Fish sampling zones, Back River system, Jamestown Island



Figure 1 - Fish Sampling Zones, Back River System, Jamestown Island, Virginia

24 miles of streams. To date nearly 2200 acres of wetlands have been mapped in Colonial NHP (roughly 24% of the park), and over 80% of Jamestown Island's acreage is wetland. Outside of park boundaries, 45,000 acres of forest and tidal wetlands surround Colonial NHP. Much of the area outside the park is experiencing rapid urban development with its associated environmental impacts to park lands from erosion and sedimentation, oil and sewer spills, and former toxic chemical disposal sites.

As developmental pressures increase, so does the value of the natural resources protected by the park. As a first step in their effort to manage these valuable resources, the park is developing an inventory of its aquatic resources. One aspect of this inventory program involved entering into an Interagency Agreement with the U.S. Fish and Wildlife Service to inventory finfish and measure baseline water quality parameters in the creeks of Yorktown Battlefield in 1987 and in waters around Jamestown Island in 1991. Specific objectives of the studies include identifying fish species present, life stages present, and species seasonality.

No fisheries investigations focusing on Colonial's waters had been conducted before the present initiative. Thirty-six fish species were observed during the Jamestown Island study. Species found ranged from those typically associated with freshwater environments to some marine species to anadromous species, (i.e., fish which swim from the sea to spawn in freshwater). Some

species captured during the 1991 study included large-mouth bass, channel catfish, bluegill, tessellated darter, striped bass, pipefish, summer flounder, white perch, Atlantic croaker, spot, and yellow perch. Various other studies reported in the database Biota of Virginia (BOVA) and by the Virginia Institute of Marine Science focused on the main channel of the James River and Powhatan Creek near Jamestown Island. The BOVA database reported that 51 fish species had been collected, and Virginia Institute for Marine Science collected 48 species. The Jamestown Island area appears to function as a nursery area for several anadromous and marine fish species, (e.g., striped bass, croaker, summer flounder), as well as providing habitat for many important resident species, (i.e., species which complete their entire life cycle in the area, such as largemouth bass, channel catfish, white perch, and yellow perch).

Wise stewardship of this unique environment by the park in conjunction with other natural resources agencies is essential to insure the integrity of the habitat values and recreational opportunities provided by the area. Based on the results of the fisheries investigations; the findings and recommendations of the rare, threatened, and endangered species report by the Virginia Department of Natural Heritage; and the final water resource management plan by the Virginia Institute of Marine Science, Colonial NHP will develop appropriate actions to ensure the continuing preservation and protection of the natural environment at Jamestown Island and throughout the park.

After the Gold Rush: Reclaiming Mined Land in Alaskan Parks

By Page Spencer, Ecologist, Alaska Regional Office, Roseann Densmore, Research Ecologist, Denali National Park and Preserve, and Ken Karle, Hydrologist, Denali National Park and Preserve

The great Alaskan gold rush of the late 1970's and early 1980's left a wake of debris, access trails, barren tailing piles, and deranged streams in several Alaskan national parks units. The Alaska Region's program of inventory, research, and reclamation on these mine-damaged lands is designed to reestablish stable ecosystems that can proceed through physical and biological succession with natural processes. Because northern environments and National Park Service policies present special opportunities and challenges, we need to find methods to "jump start" succession without introducing non-native species or artificial structures into streams.

One longterm research project searching for management alternatives is being conducted in the watershed of Glen Creek in the Kantishna Hills of Denali National Park and Preserve. Researchers are studying the recovery of aquatic and terrestrial ecosystem components using a variety of reclamation techniques. The project tests several variables that may affect the rate and pattern of revegetation: substrate characteristics, soil moisture, different plant species and density, seed and plant establishment characteristics, and use of fertilizer and inoculations of nitrogen-fixing symbionts and/or mycorrhizae.

From 1903 to 1983, placer gold mining severely disturbed the Glen Creek watershed, resulting in an unstable barren landscape. Though the stream has been stabilizing naturally since mining ceased, some stream reaches remain straight and incised, while others are broad and braided. Tailing piles of unwashed overburden buried by washed gravel are stacked throughout the disturbed area. The original topsoil washed downstream during mining.

Reclamation included reshaping 27 acres of unstable tailings along 2 miles of lower Glen Creek to gentle contours, backfilling trenches, and resspreading any available topsoil over the area. The stream channel and floodplain were designed to accommodate 2-year and 100-year flows, respectively. Material was removed from steep banks along narrow stream reaches to recreate a functional floodplain, and gravel placed to allow braided streams to build a defined channel. Boulders, alder bundles, and willow shoots protect new floodplains and stream banks from erosion. The reshaped tailings were

planted with thousands of alder seedlings and willow shoots, and spruce and soapberry seedlings will be added in 1992.

Results to date indicate that the reshaped tailing piles and backfilled trenches are stable and have reduced the erosion and slumping of steep banks. Although dirt work on stream channels and floodplains is very recent, a more natural hydrologic equilibrium is evident. Small eddy pools have formed downstream of large boulders and along the bank. As the water flow slowed, it deposited sand and small gravel in these pools. The braided stream now flows in a single channel, while the steep-banked stream reaches have established low-banked channels and a more natural floodplain.

Coarse tailings with little organic material have very poor natural revegetation. Species diversity is also low. The study shows that natural revegetation on areas with ground water seepage or resspread topsoil/overburden is as rapid as assisted plantings, and further planting, seeding, or fertilization is not helpful.

Nitrogen-fixing nodules grow on alder roots and facilitate alder establishment on barren areas where other species are limited by nutrients. Some alder seedlings were inoculated with mycorrhizae, fungi which enable a plant to absorb nutrients from the soil. The planted alder seedlings grow well, indicating that seedling establishment is the limiting factor rather than the environment of the tailings. Willow and spruce invade later, after the alder nodules have enriched the gravel substrate. Inoculated alder seedlings have grown faster than transplants infected naturally.

The overall results of the research have exciting applications for reclamation of ongoing mining operations and abandoned mine areas. The National Park Service plans similar reclamation on more than 50 acres of severe disturbance in upper Glen Creek, allowing scientists to study ecosystem recovery of an entire watershed. Mine-damaged valleys and ridges involving thousands of acres and many miles of streams are being evaluated for reclamation in Alaskan parks. The research clearly shows that the challenging job of restoring natural function to severely damaged lands is off to a good start in Alaska.



**Not Just Science!
Other Aspects of
Natural Resource
Management**

Managing Cultural Landscapes with Agricultural Practices

By Wayne Millington, Natural Resource Specialist, Delaware Water Gap National Recreation Area

Three hundred years of logging and farming have left their mark on the landscape of rolling hills, valleys, and ridges that parallels the 37 miles of the Middle Delaware National Scenic and Recreational River. Farming continues to play an important role in the Delaware Water Gap National Recreation Area's (NRA) landscape. Farming helps the park maintain a rural character, conserve scenic qualities, and enhance wildlife habitat. In an effort to conserve the scenic and historical mix of open land and forest, the park applies landscape management efforts in the form of farming and tree cutting. Delaware Water Gap NRA maintains approximately 20 percent of the resource management subzone (56% of the total park land area) as open land, 40 percent as productive forest, and 40 percent as maturing forest.

Farming also acts to perpetuate historical settlement patterns. Artifacts from early Indian settlements of the Lenni Lenape indicate that many of the agricultural fields along the Delaware River were tilled by the earliest inhabitants of the river valley. Later on, European settlers perpetuated the farming culture. One goal of Delaware Water Gap's cultural resource management program is to protect the cultural patterns of human occupation by maintaining vegetation and agricultural use patterns near historic structures, and retaining farmsteads and existing landscape configurations.

Approximately 4500 acres of the park are managed through 21 special use permits issued to seven area farmers. Three thousand acres are planted in a variety of row crops, including field and sweet corn, soybeans, rye, oats, and wheat, as well as numerous vegetables and fruits on a 90-acre truck farm. The remaining 1500 acres are maintained as open space and wildlife habitat. Agricultural special use permits are issued on a five-year basis.

Farmers develop and implement conservation plans with the assistance of the Soil Conservation Ser-

vice, the Cooperative Extension Service, and private consultants. These plans are reviewed annually to assure that the goals set forward by the National Park Service are met, and to advise the farmers on approved pest control practices and best management practices (BMPs). (BMPs are practices designed to reduce surface runoff and soil erosion.) The use of integrated pest management (IPM) techniques is mandatory. Historically, a monoculture of corn was grown on many park agricultural lands, and most pest problems were managed through routine application of chemical pesticides. However, tighter restrictions over the use of various pesticides have led to the increased use of nonchemical control options, such as crop rotation. Agricultural permittees are now required to plant non-row crops once every five years. This interrupts pest life cycles and provides the further benefit of increased landscape and wildlife habitat diversity. It may also allow a greater success rate with chemical treatments when they are used.

The use of BMPs is required as a condition of each agricultural special use permit in order to reduce the surface runoff to local waters, including the Delaware River. Hedgerows, filter strips, and field borders--often planted in native species of trees, shrubs, and grasses--



filter sediments, nutrients, and pesticides out of surface runoff and enhance wildlife habitat. Other BMPs used at the park include planting cover crops to stabilize the soil during non-cropping periods and using minimum-tillage farming to reduce soil loss and disturbance.

In 1991, in order to assist the farmers in meeting National Park Service management goals, Delaware Water Gap NRA funded the enrollment of 2300 acres of farmland into a local Crop Management Association. Permittees are now required to enroll all leased cropland acres into the Association. The Association performs "field scouting" to document cropping practices and yields, and to monitor pest problems (weeds, insects, disease, etc.). Recommendations for action are made

based on these weekly field surveys. Crop scouts work for the farmers; they do not benefit from product sales, and so do not encourage unnecessary applications of pesticides. Field reports allow the park to evaluate cropping and pest management practices, and also serve as an invaluable monitoring record. These records enhance future planning and resource protection efforts.

At Delaware Water Gap NRA, the goal is to achieve an integrated crop management approach that incorporates the many variables (IPM, weeds, disease, insects, soil pH and fertility, erosion and sedimentation concerns, crop planting costs, and harvest values) involved in maintaining a successful agricultural program that also protects park resource values.

Trespass Issues at Coulee Dam National Recreation Area

By George Phillips, Management Assistant, and Karen Taylor-Goodrich, Natural Resource Specialist, Coulee Dam National Recreation Area

A 1988 field survey of the 150-mile-long Coulee Dam National Recreation Area (NRA) identified over 150 cases of trespass by adjacent landowners on public lands administered by the National Park Service. An estimated 250 cases remain unidentified. In many cases, an individual was responsible for multiple incidents of trespass. The trespasses included livestock use, maintained trails, roads, irrigation systems, buried gas tanks, boat docks, stairways, and manicured lawns.

The acceleration of private development and public use are causing present and projected conflicts at Lake Roosevelt. Visitation has increased dramatically at Coulee Dam NRA, from 500,000 visitors in 1985 to over 1.7 million visitors in 1991. The privatization of public lands by individuals and special interest groups is becoming a serious concern for the National Park Service and other federal and state agencies in the Lake Roosevelt area. Financial interest is a prime motivation to adjacent landowners to trespass on public lands along Lake Roosevelt. In most cases, property values increase if the public lakeshore can be used as an extension of adjacent private parcels. As more private lands are developed adjacent to the Coulee Dam NRA, the threat of encroachment from external sources increases. The cumulative effects of trespasses on public lands result in

degradation of native vegetation, wildlife species and their habitat, water and air resources, soils, beaches, and other features of biological and social value.

In response to this compounding resource management issue, Coulee Dam NRA hired two additional rangers to identify, document, and resolve trespass issues. Some trespass cases can be resolved by voluntary compliance to Park Service directives ordering the removal of trespass facilities and restoration of the natural resources; others go to full prosecution by the U.S. Attorney with associated court-ordered restitution.

In addition to improving our trespass enforcement capabilities, other management actions have reinforced efforts to address land use issues. A natural resource specialist position was established in order to provide overall direction to the park's resource management operation, and a Special Park Use Management Plan has been implemented. This plan is controversial in that it phases out inappropriate park uses and restricts future uses to those that fall within approved management objectives.

By tackling land use conflicts internally and by improving our capabilities in the field, we will be better prepared to face the ever-increasing pressures on this prime resource.

People and Bears Learn to Live Together at Redwood National Park

By Sabra Steinberg, Wildlife Biologist, Redwood National Park

Resource managers in parks with bear populations face a distinctive management challenge; they must manage human and bear populations to cut down on the number and severity of negative interactions inside and outside park boundaries while maintaining a natural bear population. Because of its narrow configuration, Redwood National Park is especially vulnerable to influences from outside sources, and bears' movements are not determined by human-designated boundaries. Therefore, rather than treat the park as an isolated unit, the bear management program at Redwood focuses on activities and facilities outside park boundaries as well as inside.

Management activities in 1991 under Redwood's newly revised Bear Management Plan included coordinating with other agencies on preventative measures as well as dealing with "problem bears." An interagency Black Bear Working Group deals with many bear-related issues affecting the park and the local area. The group includes representatives from the state park system, the Department of Fish and Game, and Redwood National Park.

Other actions taken this year involve public education. In the spring, outreach programs for local communities were developed to provide information on bear ecology and bear management. "Bear Facts" interpretive displays were designed for visitor centers and the Wolf Creek Outdoor School in the park; the park also donated displays to the local chamber of commerce and to Prairie Creek State Park, at their request. State park personnel and Redwood National Park biologists developed a slide show on bears which was presented to local chambers of commerce, contractors working in or near the park, and even a minimum security prison adjacent to the park. This educational program will be continued and expanded in the future. Park biologists also gave bear talks to

park staff, Youth Conservation Corps crews, contractors working in the park, and various groups at the outdoor school. As in previous years, a three-day field seminar on bears was offered to the public. Since visitor education on bear regulations is not effective without means to comply, the park has added bear-proof lockers at established campsites.

Dealing with bear incidents is always a consideration in bear management. During the summer, there were several bear incidents at Wolf Creek Outdoor School and at the nearby Prairie Creek State Park. Redwood National Park biologists provided technical assistance in the capture and marking of problem bears at the state park, and were diligent in aversive conditioning of habituated bears within national park boundaries. Because law enforcement rangers were often the first to respond to reports of bear problems, they received training in aversive conditioning techniques; this training will be provided annually.

Bear management at Redwood National Park doesn't end when the bears den up for the winter. In 1991, park biologists investigated facilities (campgrounds, hostels, picnic areas, the outdoor school) in the park for compliance with the Bear Management Plan, and identified problem areas and made recommendations. Early identification of necessary changes provided the Maintenance Division with enough lead-time to take action before the summer "bear season."

Whether bears are out foraging or denned up for the winter, a major component of proactive bear management is ensuring that human foods are inaccessible to bears. This process involves educating employees, visitors, and local communities on their responsibilities and the ramifications of their actions. In this sense, bear management occurs all year at Redwood National Park.



Carol Stalder, a wildlife artist in McKinleyville, California, donated her drawing of a grizzly bear to Golden Gate National Park. Carol's art has also been used extensively in educational materials at Golden Gate's Wolf Creek Outdoor School.



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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